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Bibliography of Ion-Molecule Reaction Rate Data

(January 1950-October 1971)

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NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards¹ was established by an act of Congress March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau consists of the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Center for Computer Sciences and Technology, and the Office for Information Programs.

THE INSTITUTE FOR BASIC STANDARDS provides the central basis within the United States of a complete and consistent system of physical measurement; coordinates that system with measurement systems of other nations; and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of a Center for Radiation Research, an Office of Measurement Services and the following divisions:

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Office of Standard Reference Data—Office of Technical Information and Publications—Library—Office of International Relations.

¹ Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

² Part of the Center for Radiation Research.

³ Located at Boulder, Colorado 80302.

⁴ Part of the Center for Building Technology.

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Bibliography of Ion-Molecule Reaction Rate Data (January 1950-October 1971)

George A. Sinnott

Laboratory Astrophysics Division
Institute for Basic Standards
National Bureau of Standards
Boulder, Colorado 80302



U.S. DEPARTMENT OF COMMERCE, Frederick B. Dent, *Secretary*
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, *Director*

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Foreword

The National Standard Reference Data System was established in 1963 for the purpose of promoting the critical evaluation and dissemination of numerical data of the physical sciences. The program is coordinated by the Office of Standard Reference Data of the National Bureau of Standards but involves the efforts of many groups in universities, government laboratories, and private industry. The primary aim of the program is to provide compilations of critically evaluated physical and chemical property data. These tables are published in the *Journal of Physical and Chemical Reference Data*, in the NSRDS-NBS series of the National Bureau of Standards, and through other appropriate channels.

The task of critical evaluation is carried out in various data centers, each with a well-defined technical scope. A necessary preliminary step to the critical evaluation process is the retrieval from the world scientific literature of all papers falling within the scope of the center. Each center, therefore, builds up a comprehensive well-indexed bibliographical file which forms the base for the evaluation task. Bibliographies derived from these files are published when they appear to be of value to research workers and others interested in the particular technical area.

Further information on NSRDS and the publications which form the primary output of the program may be obtained by writing to the Office of Standard Reference Data, National Bureau of Standards, Washington, DC 20234.

David R. Lide, Jr., Chief
Office of Standard Reference Data

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Bibliography of Ion-Molecule Reaction Rate Data

(January 1950—October 1971)

George Sinnott*

A bibliography is presented of papers in the open literature that contain original experimental data on ion-molecule reaction rates or cross sections. Positive and negative ion-molecule and ion-ion reactions are included by not electron impact processes. For papers to be included, the reactants must have been identified and data for kinetic energies below 10 electron volts must have been presented.

Key words: Atoms; bibliography; cross-sections; ions; molecules; rate coefficients; reactions.

Introduction

This bibliography is an updating of the bibliography published in August 1969 as Joint Institute for Laboratory Astrophysics (JILA) Information Center Report No. 9. The present version includes references (available as of 1 October 1971) to papers reporting measurements of ion-molecule reaction rates for atoms and simple molecules. The bibliography is intended to be of particular interest to workers in the field of aeronomy, as well as to investigators of ion-molecule processes.

References were obtained by a search of the open, published literature for papers containing original *experimental* data on ion-molecule reaction cross sections or rate constants. In particular, the processes included are: charge exchange between positive or negative ions and neutral molecules or atoms; heavy particle exchange between positive or negative ions and neutral molecules or atoms; reaction of excited neutrals with neutrals to create ionized species; and ion-ion reactions. Electron collision processes were excluded, as these are covered in another bibliography already compiled at the JILA Information Center. Papers presenting cross section data are listed only if the kinetic energies of the molecules or atoms were 10 electron volts or less. All atomic species are included. The molecules selected are those considered to be of potential interest to

aeronomists, astrophysicists, and plasma physicists. In particular, no attempt has been made to include heavy organic molecules. Papers are included only if they identify the reactant species; the right-hand side of the entry equation is left blank if the product species are not identified. The neutral products were omitted from the reaction equations.

The searching procedure began with a title search of *Science Abstracts*, Series A, *Physics Abstracts* from 1960 to the cut-off date, plus scanning the bibliographies of published relevant reviews. Papers found in this way were read to obtain references to other papers purporting to contain data.

Finally, the following journals were searched for recent papers:

Physical Review A
Physical Review Letters
Journal of Chemical Physics
Journal of Geophysical Research (blue and green)
Planetary and Space Science

The bibliography is organized in three sections, each keyed to the citation number of the individual references. These citation numbers are arbitrary designators used for internal organization of the JILA Information Center master bibliography. The same number is always coupled to any single reference, and may appear in more than one bibliography compiled at JILA. Consequently, not all numbers appear in any specialized bibliography, and in particular, the sequence of citation numbers listed here has gaps.

*Present address: Fire Technology Division, Institute for Applied Technology, National Bureau of Standards, Washington, D.C. 20234.

¹Kieffer, L. J., *Bibliography of Low Energy Electron Collision Cross Section Data*, Nat. Bur. Stand. (U.S.), Misc. Publ. 289, 95 pages (March 1967).

The first section is a listing of reaction equations with associated citation numbers, plus the name of the first author and the year of publication. The equations are divided into six major categories:

- Two Body, Positive Ion—Negative Ion
- Two Body, Positive Ion—Neutral
- Two Body, Negative Ion—Neutral
- Two Body, Excited Neutral—Neutral
- Three Body, Positive—Neutral—Neutral
- Three Body, Negative—Neutral—Neutral.

Within each category, reaction equations are listed in accordance with the following rules for the rank of the reacting species:

1. Positive ion; then negative ion; then excited neutral; then ground state neutral.
2. Within each class in (1) above, species are ranked by largest Z-number atom in ascending order of Z-number. Where two species have the same largest Z-number atom, they are further ordered by Z-number of the remaining atoms.

These rules would lead, for example, to the following order: $+O$, H^- , N , O , CO , COH_2 , NO , O_2 , CO_2 .

Each reaction equation is written with the reacting (and product) species ordered by increasing rank. The equations themselves are listed in rank order of the first species; for identical first species in order of the second species, etc.

The second section lists the full references in order of their citation numbers.

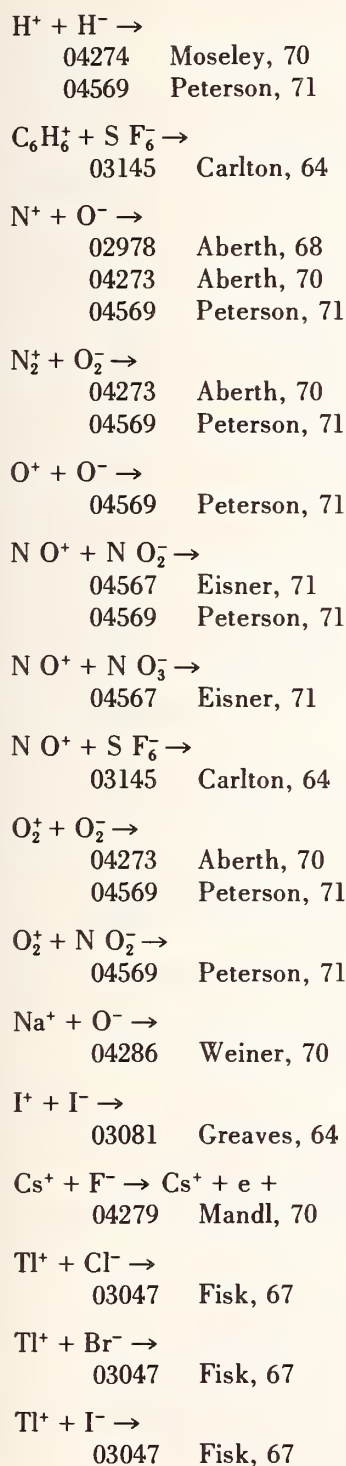
The third section is an alphabetical author index with citation numbers. All authors of each paper are included.

It should be kept in mind that inclusion of a reference in this bibliography does not imply a value judgment about the accuracy of the information. The only criteria for selection were that the reference reports a measurement of a cross section or reaction rate and that the reactant species are identified.

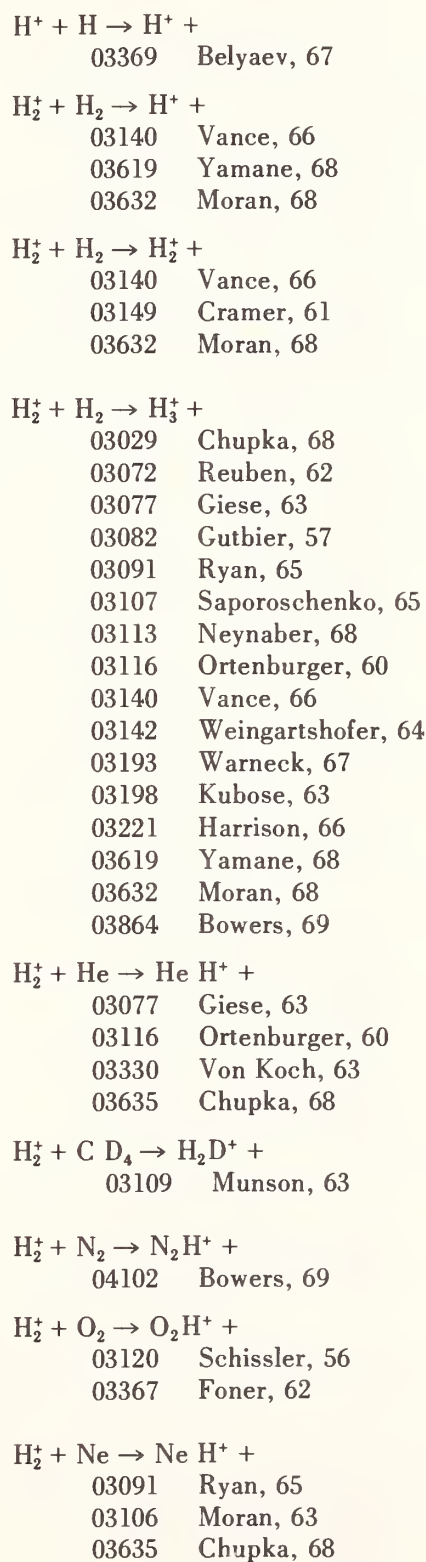
The author would like to acknowledge the help, encouragement and philosophical perspective received from Dr. Lee Kieffer throughout this project.

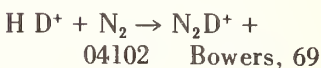
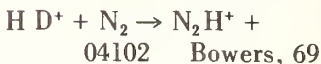
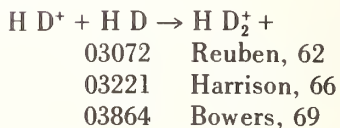
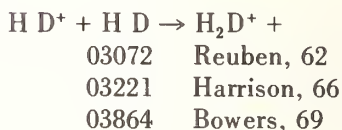
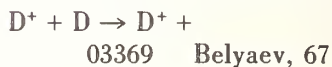
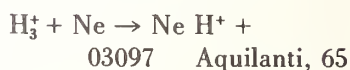
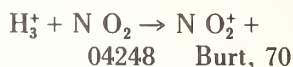
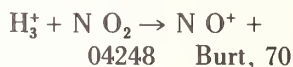
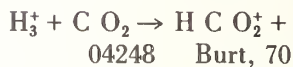
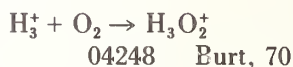
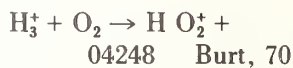
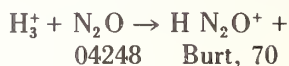
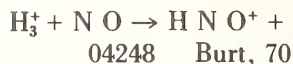
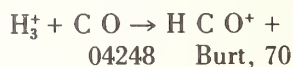
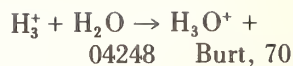
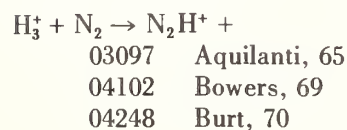
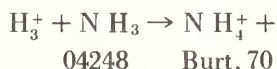
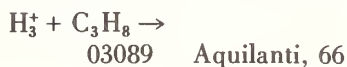
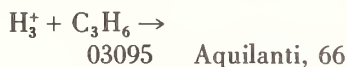
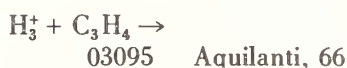
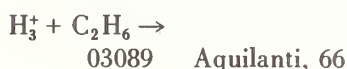
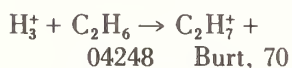
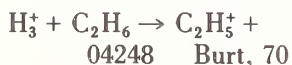
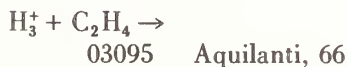
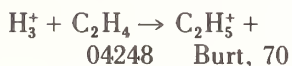
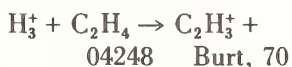
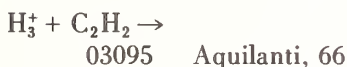
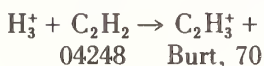
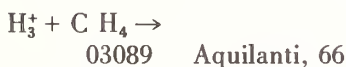
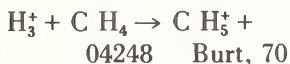
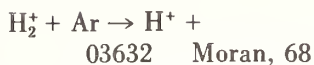
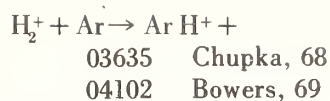
Reaction Equations

Two Body, Positive Ion-Negative Ion



Two Body, Positive Ion-Neutral

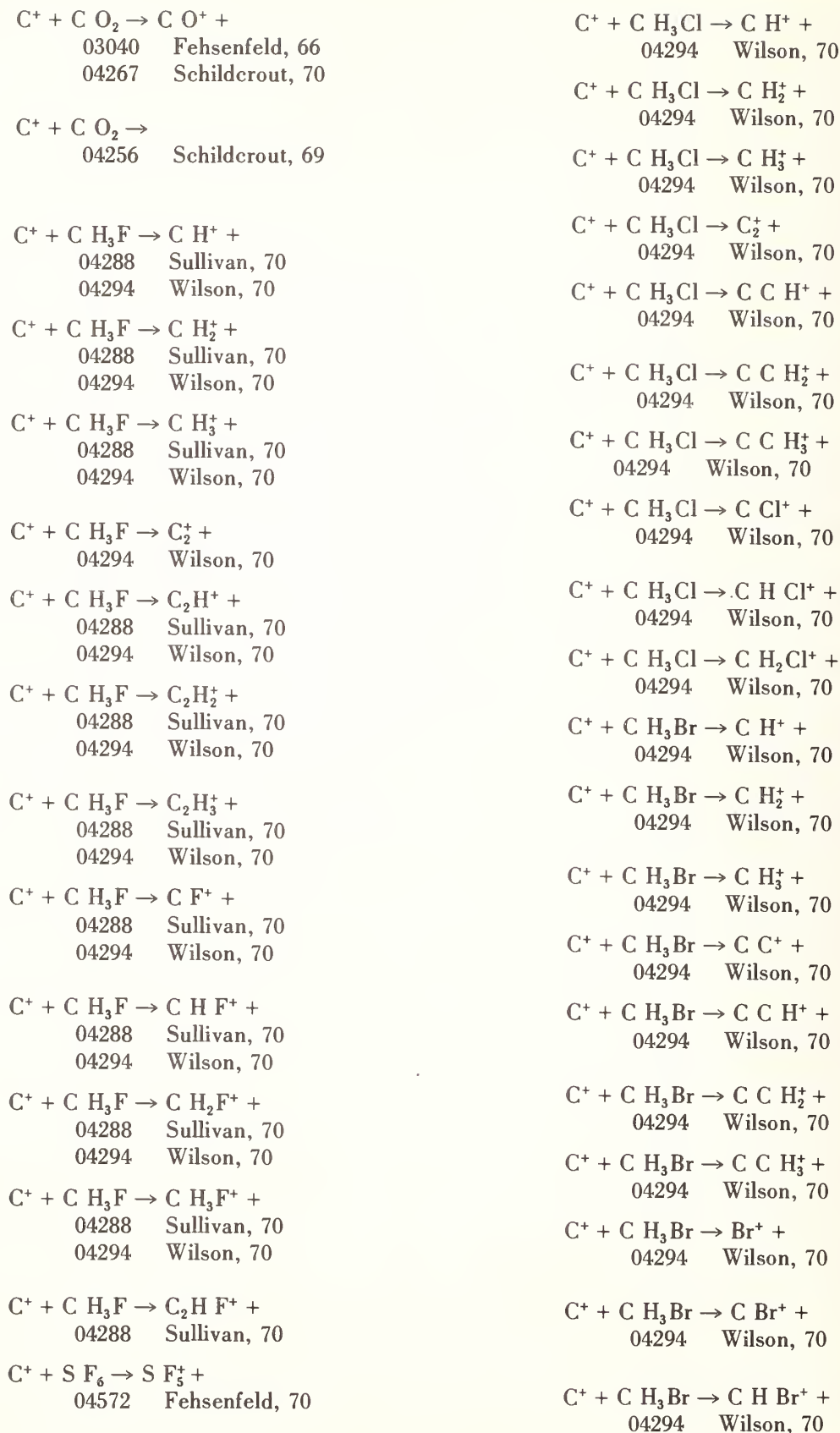


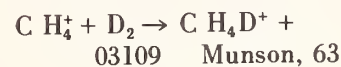
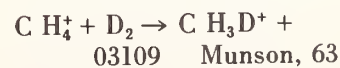
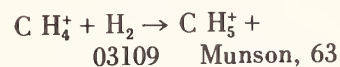
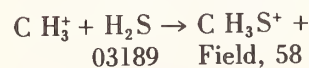
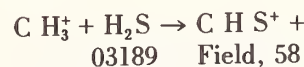
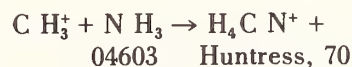
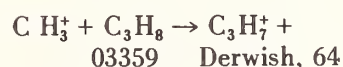
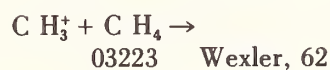
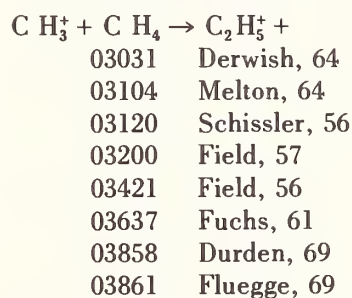
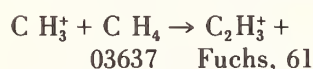
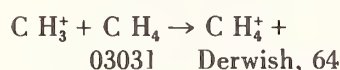
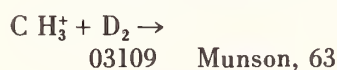
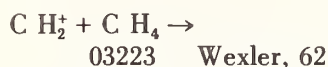
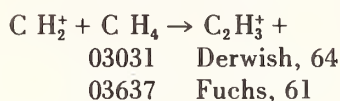
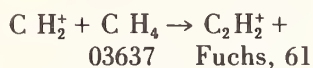
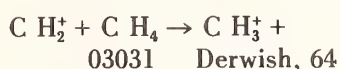
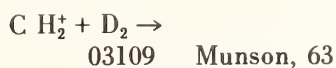
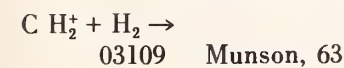
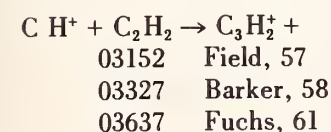
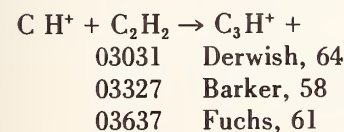
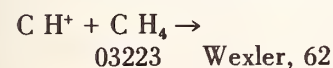
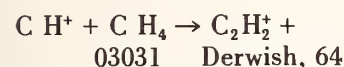
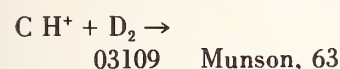
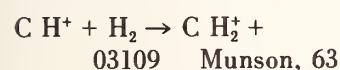
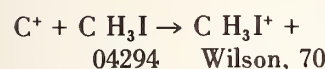
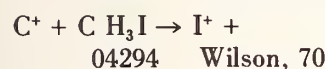
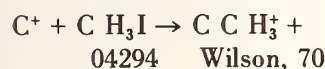
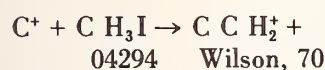
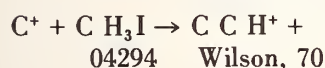
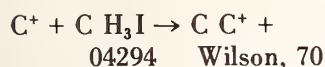
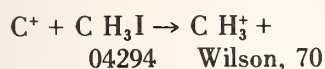
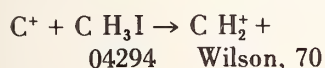
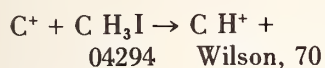
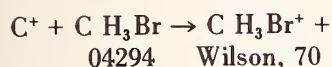
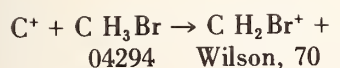


H D ⁺ + Ar → Ar ⁺ +	D ₂ ⁺ + Ar → Ar D ⁺ +
03335 Berta, 64	03077 Giese, 63
H D ⁺ + Ar → Ar H ⁺ +	03083 Harrison, 67
03335 Berta, 64	03364 Shannon, 65
04102 Bowers, 69	04102 Bowers, 69
H D ⁺ + Ar → Ar D ⁺ +	D ₂ ⁺ + As H ₃ → D ₂ H ⁺ +
03335 Berta, 64	03074 Giardini - Guidoni, 60
04102 Bowers, 69	D ₃ ⁺ + C H ₄ →
D ₂ ⁺ + H ₂ → D ₂ H ⁺ +	03089 Aquilanti, 66
03198 Kubose, 63	D ₃ ⁺ + C ₂ H ₂ →
D ₂ ⁺ + D ₂ → D ₃ ⁺ +	03095 Aquilanti, 66
03072 Reuben, 62	D ₃ ⁺ + C ₂ H ₄ →
03091 Ryan, 65	03095 Aquilanti, 66
03132 Stevenson, 55	D ₃ ⁺ + C ₂ H ₆ →
03133 Stevenson, 58	03089 Aquilanti, 66
03221 Harrison, 66	D ₃ ⁺ + C ₃ H ₄ →
03864 Bowers, 69	03095 Aquilanti, 66
D ₂ ⁺ + D ₂ → D ₃ ⁺ +	D ₃ ⁺ + C ₃ H ₆ →
03198 Kubose, 63	03095 Aquilanti, 66
D ₂ ⁺ + C H ₄ → D ₂ H ⁺ +	D ₃ ⁺ + C ₃ H ₈ →
03109 Munson, 63	03089 Aquilanti, 66
D ₂ ⁺ + C H ₄ → C H ₄ D ⁺ +	D ₃ ⁺ + N ₂ → N ₂ D ⁺ +
03084 Hand, 64	04102 Bowers, 69
D ₂ ⁺ + N H ₃ → D ₂ H ⁺ +	D ₃ ⁺ + Ar → Ar D ⁺ +
03074 Giardini - Guidoni, 60	04102 Bowers, 69
D ₂ ⁺ + C H ₃ C N → C H ₃ C N D ⁺ +	He ⁺ + H ₂ → H ⁺ +
03083 Harrison, 67	03079 Rozett, 68
03364 Shannon, 65	03153 Friedman, 65
D ₂ ⁺ + N ₂ → N ₂ D ⁺ +	He ⁺ + H ₂ → He H ⁺ +
03077 Giese, 63	03082 Gutbier, 57
04102 Bowers, 69	03097 Aquilanti, 65
D ₂ ⁺ + C O → C O D ⁺ +	03116 Ortenburger, 60
03083 Harrison, 67	He ⁺ + H ₂ →
03364 Shannon, 65	03037 Fehsenfeld, 66
D ₂ ⁺ + O ₂ → O ₂ D ⁺ +	04283 Bolden, 70
03120 Schissler, 56	He ⁺ + H D → H ⁺ +
D ₂ ⁺ + C O ₂ → C O ₂ D ⁺ +	03079 Rozett, 68
03083 Harrison, 67	He ⁺ + H D → D ⁺ +
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D ₂ ⁺ + P H ₃ → D ₂ H ⁺ +	
03074 Giardini - Guidoni, 60	

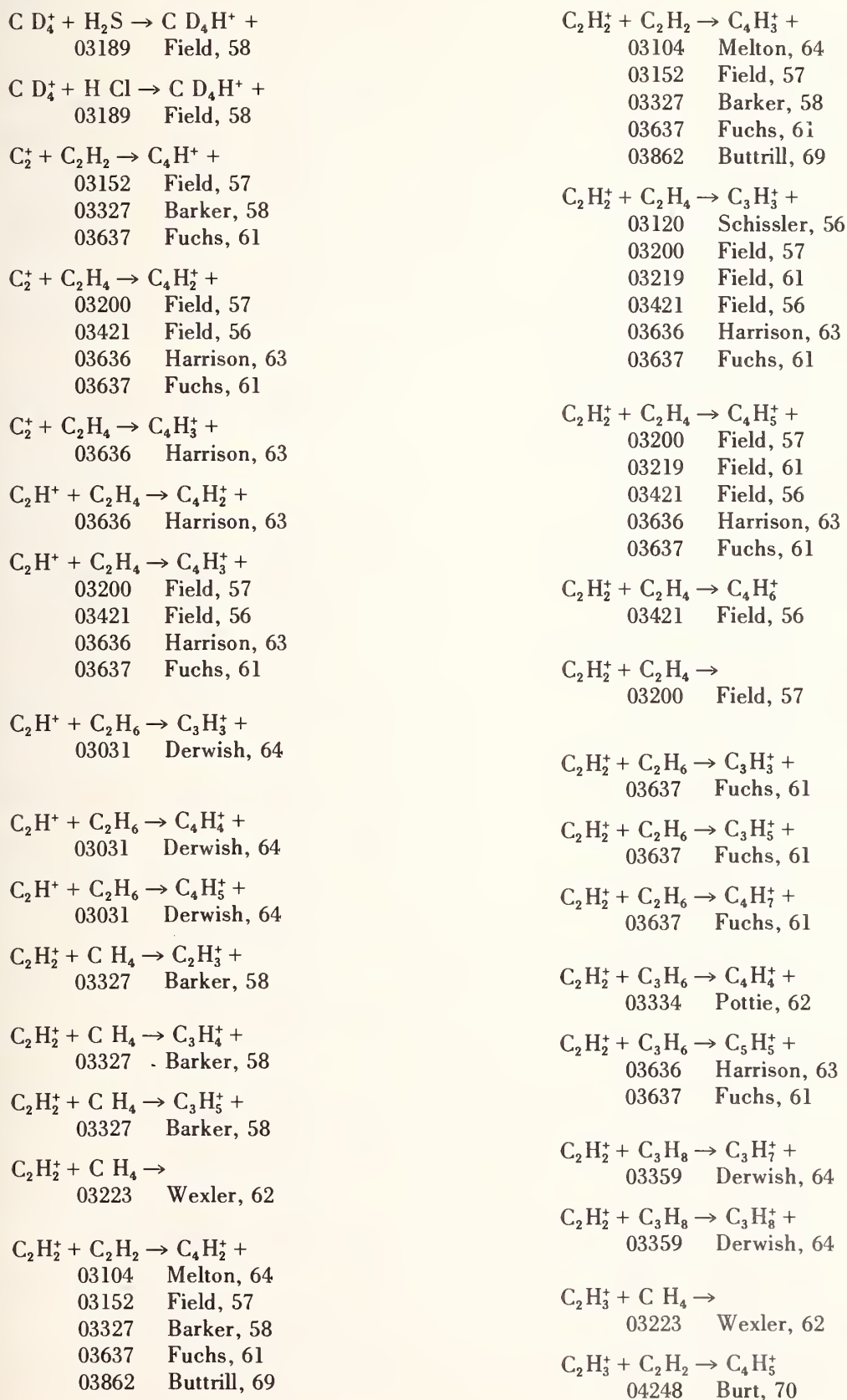
He ⁺ + He → He ⁺ +	He ⁺ + N ₂ →
03362 Mahadevan, 68	03407 Dunkin, 68
03866 Belyaev, 69	04283 Bolden, 70
He ⁺ + C H ₄ → C ⁺ +	He ⁺ + H ₂ O →
03325 Hertel, 65	04533 Howard, 70
He ⁺ + C H ₄ → C H ⁺ +	He ⁺ + C O → C ⁺ +
03325 Hertel, 65	03037 Fehsenfeld, 66
	03076 Giese, 63
	03197 Moran, 66
He ⁺ + C H ₄ → C H ₂ ⁺ +	He ⁺ + C O →
03325 Hertel, 65	04283 Bolden, 70
He ⁺ + C H ₄ → C H ₃ ⁺ +	He ⁺ + N O → N ⁺ +
03325 Hertel, 65	03037 Fehsenfeld, 66
	03197 Moran, 66
He ⁺ + C H ₄ →	He ⁺ + N O →
04283 Bolden, 70	04283 Bolden, 70
He ⁺ + C ₂ H ₄ →	He ⁺ + O ₂ → O ⁺ +
03199 Franklin, 61	03037 Fehsenfeld, 66
	03049 Fite, 63
He ⁺ + N H ₃ →	03119 Sayers, 64
04283 Bolden, 70	03129 Stebbings, 65
	03141 Warneck, 67
He ⁺ + N ₂ → N ⁺ +	03195 Aquilanti, 66
03037 Fehsenfeld, 66	03355 Maier, 68
03119 Sayers, 64	04104 Schlumbohm, 69
03129 Stebbings, 65	04266 Farragher, 70
03141 Warneck, 67	04281 Heimerl, 69
03195 Aquilanti, 66	He ⁺ + O ₂ → O ₂ ⁺ +
03197 Moran, 66	03129 Stebbings, 65
03354 Schmeltekopf, 68	04266 Farragher, 70
03355 Maier, 68	04281 Heimerl, 69
03853 Ong, 69	He ⁺ + O ₂ →
04104 Schlumbohm, 69	04283 Bolden, 70
04266 Farragher, 70	He ⁺ + C O ₂ → O ⁺ +
04281 Heimerl, 69	03037 Fehsenfeld, 66
He ⁺ + N ₂ → N ₂ ⁺ +	He ⁺ + C O ₂ → C O ⁺ +
03129 Stebbings, 65	03037 Fehsenfeld, 66
03141 Warneck, 67	He ⁺ + C O ₂ →
03354 Schmeltekopf, 68	04283 Bolden, 70
03355 Maier, 68	He ⁺ + Ne → Ne ⁺ +
03853 Ong, 69	03037 Fehsenfeld, 66
04266 Farragher, 70	
04281 Heimerl, 69	

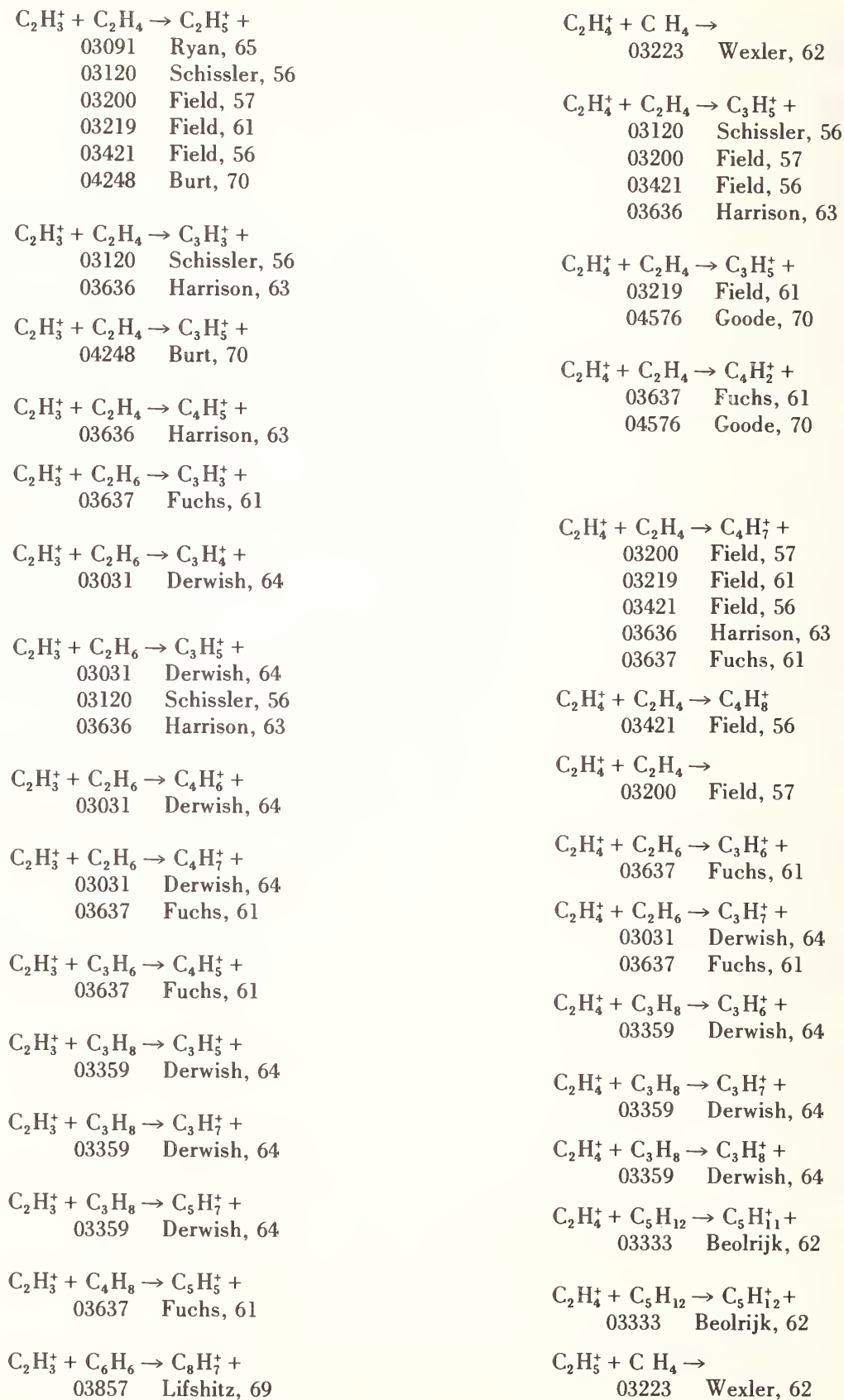
$\text{He}^+ + \text{S F}_6 \rightarrow \text{S F}_3^+ +$ 04572 Fehsenfeld, 70	$\text{He}_2^+ + \text{Ar} \rightarrow \text{Ar}^+ +$ 04289 Bohme, 7
$\text{He}^+ + \text{S F}_6 \rightarrow \text{S F}_4^+ +$ 04572 Fehsenfeld, 70	$\text{He}_2^+ + \text{Kr} \rightarrow \text{Kr}^+ +$ 04289 Bohme, 70
$\text{He}^+ + \text{S F}_6 \rightarrow \text{S F}_5^+ +$ 04572 Fehsenfeld, 70	$\text{He}_2\text{H}^+ + \text{H}_2 \rightarrow$ 04285 Adams, 70
$\text{He}^+ + \text{Ar} \rightarrow \text{Ar}^+ +$ 03037 Fehsenfeld, 66 03362 Mahadevan, 68	$\text{C}^+ + \text{D}_2 \rightarrow \text{C D}^+ +$ 03102 Maier, 67
$\text{He}^+ + \text{Ar} \rightarrow$ 04283 Bolden, 70	$\text{C}^+ + \text{C} \rightarrow \text{C}^+ +$ 03866 Belyaev, 69
$\text{He}^+ + \text{Kr} \rightarrow$ 04283 Bolden, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C H}^+ +$ 04264 Wilson, 70
$\text{He}^+ + \text{Xe} \rightarrow$ 04283 Bolden, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C H}_2^+ +$ 04264 Wilson, 70
$\text{He H}^+ + \text{H}_2 \rightarrow$ 04285 Adams, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C H}_3^+ +$ 04264 Wilson, 70
$\text{He H}_2^+ + \text{H}_2 \rightarrow$ 04285 Adams, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C H}_4^+ +$ 04264 Wilson, 70
$\text{He}_2^+ + \text{H}_2 \rightarrow$ 04285 Adams, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C}_2\text{H}^+ +$ 04264 Wilson, 70
$\text{He}_2^+ + \text{N}_2 \rightarrow \text{N}_2^+ +$ 03037 Fehsenfeld, 66 04289 Bohme, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C}_2\text{H}_2^+ +$ 04264 Wilson, 70
$\text{He}_2^+ + \text{C O} \rightarrow \text{C O}^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{C H}_4 \rightarrow \text{C}_2\text{H}_3^+ +$ 04264 Wilson, 70
$\text{He}_2^+ + \text{N O} \rightarrow \text{N O}^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{N}_2 \rightarrow \text{N}^+ +$ 03634 Lao, 68
$\text{He}_2^+ + \text{O}_2 \rightarrow \text{O}^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{N}_2 \rightarrow \text{C N}^+ +$ 03634 Lao, 68
$\text{He}_2^+ + \text{O}_2 \rightarrow \text{O}_2^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{N}_2 \rightarrow \text{N}_2^+ +$ 03634 Lao, 68
$\text{He}_2^+ + \text{C O}_2 \rightarrow \text{O}^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{C O} \rightarrow \text{C}_2\text{O}^+ +$ 03368 Saporoschenko, 68
$\text{He}_2^+ + \text{C O}_2 \rightarrow \text{C O}^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{O}_2 \rightarrow \text{O}^+ +$ 03634 Lao, 68
$\text{He}_2^+ + \text{C O}_2 \rightarrow \text{C O}_2^+ +$ 04289 Bohme, 70	$\text{C}^+ + \text{O}_2 \rightarrow \text{C O}^+ +$ 03040 Fehsenfeld, 66 03634 Lao, 68
$\text{He}_2^+ + \text{Ne} \rightarrow \text{Ne}^+ +$ 03037 Fehsenfeld, 66 04289 Bohme, 7	$\text{C}^+ + \text{O}_2 \rightarrow \text{O}_2^+ +$ 03634 Lao, 68

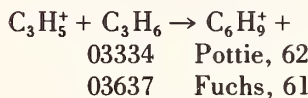
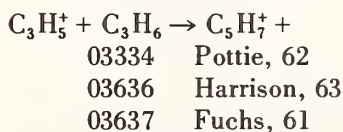
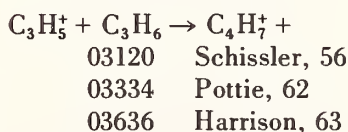
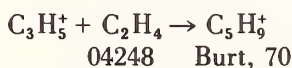
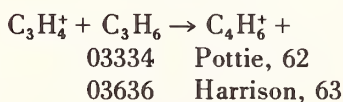
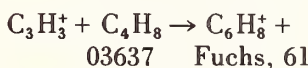
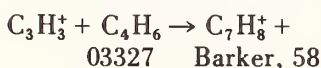
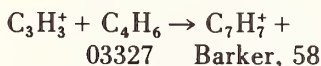
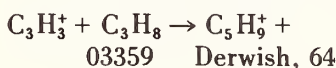
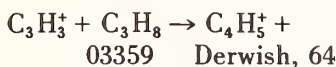
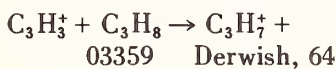
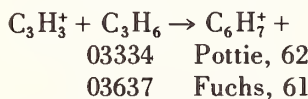
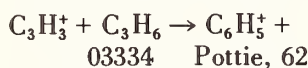
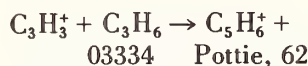
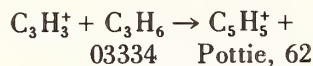
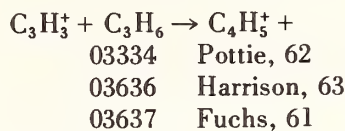
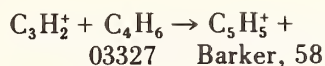
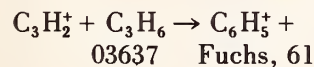
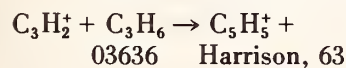
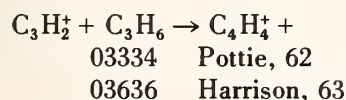
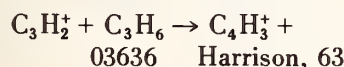
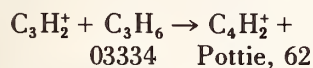
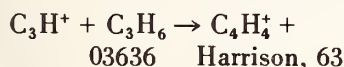
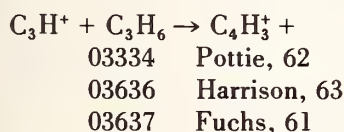
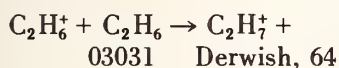
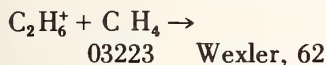
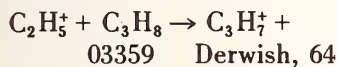
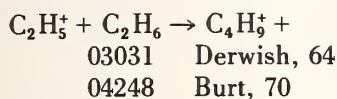
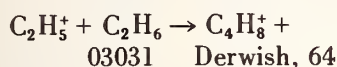
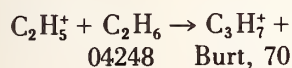
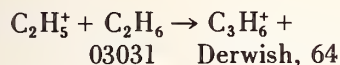
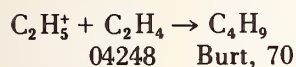
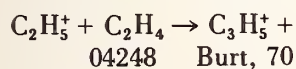
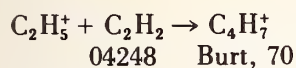
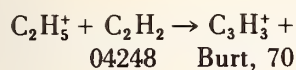


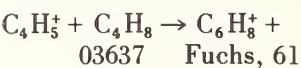
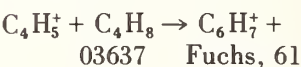
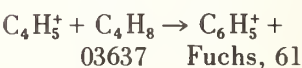
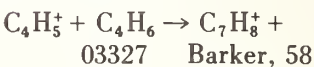
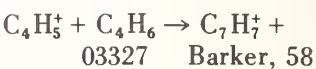
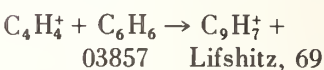
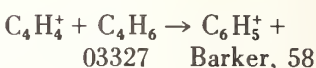
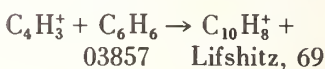
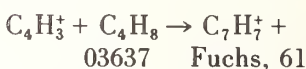
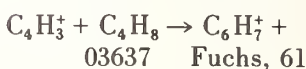
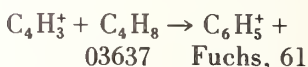
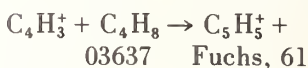
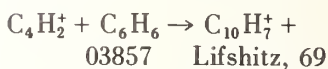
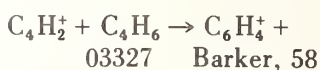
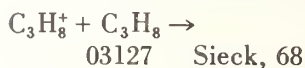
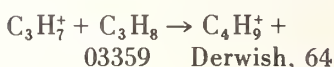
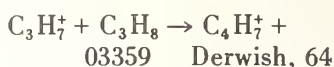
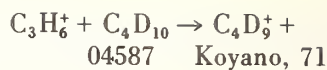
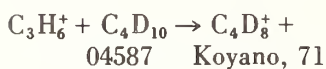
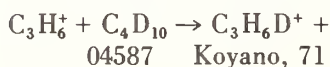
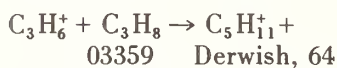
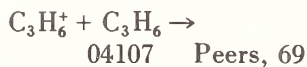
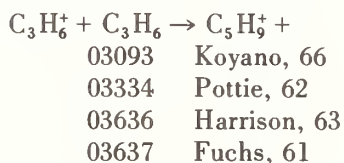
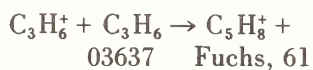
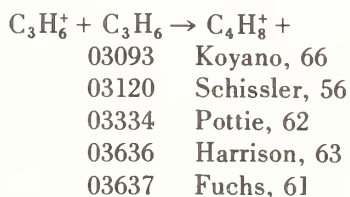
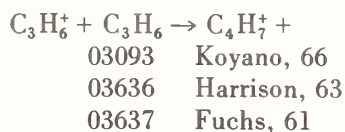
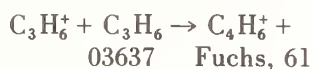
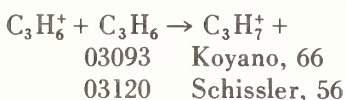
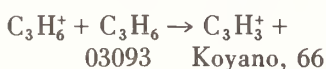
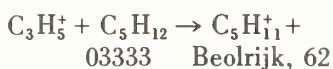
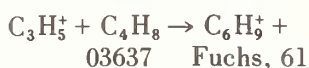
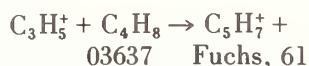
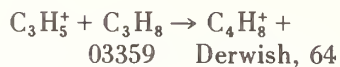
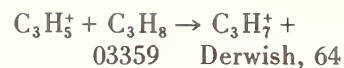


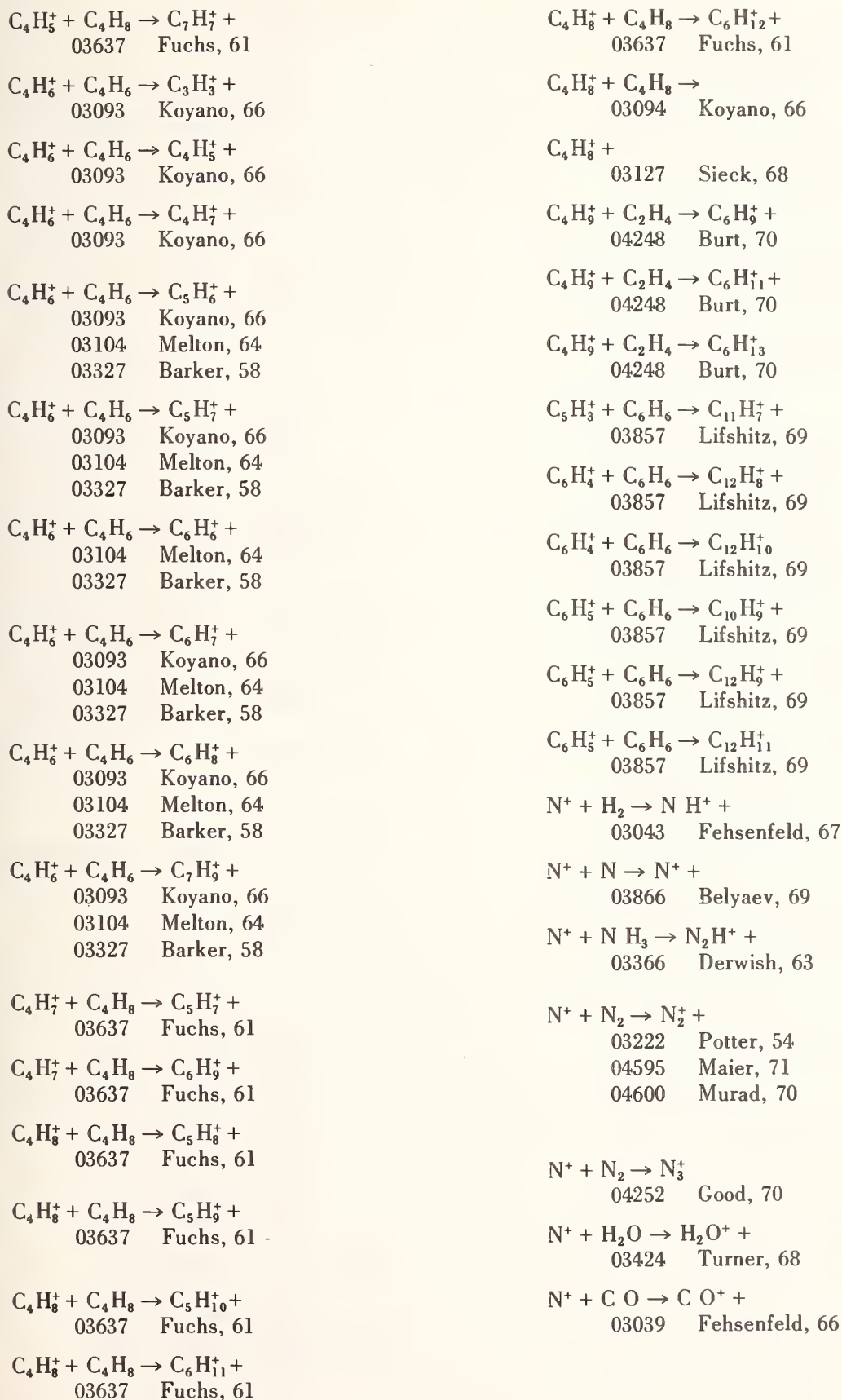
- $C H_4^+ + D_2 \rightarrow C H_3 D_2^+ +$
 03109 Munson, 63
- $C H_4^+ + C H_4 \rightarrow C H_3^+ +$
 03075 Giardini - Guidoni, 60
- $C H_4^+ + C H_4 \rightarrow C H_5^+ + C H_3$
 03031 Derwish, 64
 03075 Giardini - Guidoni, 60
 03091 Ryan, 65
 03092 Ryan, 66
 03104 Melton, 64
 03124 Shannon, 67
 03134 Talrose, 60
 03146 Colgate, 66
 03189 Field, 58
 03200 Field, 57
 03221 Harrison, 66
 03226 Hand, 64
 03421 Field, 56
 03423 Gupta, 67
 03858 Durden, 69
 03861 Fluegge, 69
 03862 Buttrill, 69
 04295 Ryan, 70
- $C H_4^+ + C H_4 \rightarrow C_2 H_7^+ +$
 03031 Derwish, 64
- $C H_4^+ + C H_4 \rightarrow$
 03223 Wexler, 62
- $C H_4^+ + C_2 H_2 \rightarrow C_3 H_3^+ +$
 03327 Barker, 58
- $C H_4^+ + H_2 S \rightarrow C H S^+ +$
 03189 Field, 58
- $C H_4^+ + H_2 S \rightarrow C H_3 S^+ +$
 03189 Field, 58
- $C H_4^+ + H Cl \rightarrow C H_5^+ +$
 03189 Field, 58
- $C H_4^+ + Hg \rightarrow C H_2 Hg^+ +$
 03201 Herman, 63
- $C H_4^+ + Hg \rightarrow C H_3 Hg^+ +$
 03201 Herman, 63
- $C H_5^+ + C H_4 \rightarrow$
 03223 Wexler, 62
- $C D^+ + H_2 \rightarrow$
 03109 Munson, 63
- $C H_3 D^+ + C H_3 D \rightarrow C H_4 D^+ +$
 03221 Harrison, 66
 03423 Gupta, 67
- $C H_3 D^+ + C H_3 D \rightarrow C H_3 D_2^+ +$
 03221 Harrison, 66
 03423 Gupta, 67
- $C H_2 D_2^+ + C H_2 D_2 \rightarrow C H_3 D_2^+ +$
 03221 Harrison, 66
 03423 Gupta, 67
 03862 Buttrill, 69
- $C H_2 D_2^+ + C H_2 D_2 \rightarrow C H_2 D_3^+ +$
 03221 Harrison, 66
 03423 Gupta, 67
 03862 Buttrill, 69
- $C D_3^+ + H_2 \rightarrow$
 03109 Munson, 63
- $C D_3^+ + C D_4 \rightarrow C_2 D_5^+ +$
 03120 Schissler, 56
- $C D_3^+ + C D_4 \rightarrow C_2 D_5^+ +$
 03198 Kubose, 63
- $C H D_3^+ + C H D_3 \rightarrow C H_2 D_3^+ +$
 03221 Harrison, 66
 03423 Gupta, 67
- $C H D_3^+ + C H D_3 \rightarrow C H D_4^+ +$
 03221 Harrison, 66
 03423 Gupta, 67
- $C D_4^+ + C D_4 \rightarrow C D_5^+ +$
 03125 Shannon, 67
 03132 Stevenson, 55
 03189 Field, 58
 03198 Kubose, 63
 03221 Harrison, 66
 03423 Gupta, 67
- $C D_4^+ + N_2 \rightarrow N_2 D^+ +$
 03083 Harrison, 67
 03125 Shannon, 67
- $C D_4^+ + C O \rightarrow C O D^+ +$
 03083 Harrison, 67
 03125 Shannon, 67
 03221 Harrison, 66
- $C D_4^+ + C O_2 \rightarrow C O_2 D^+ +$
 03083 Harrison, 67
 03125 Shannon, 67



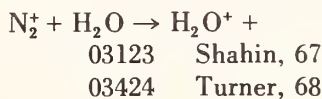
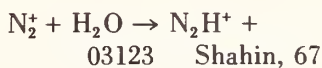
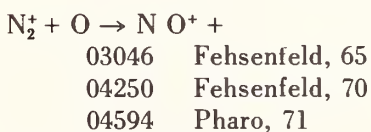
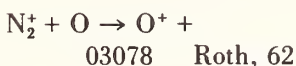
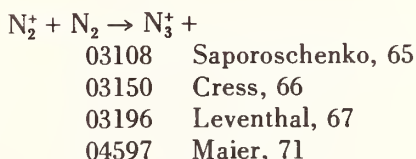
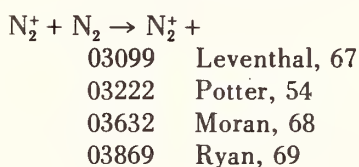
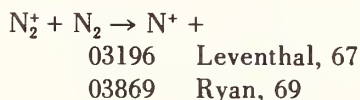
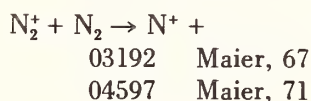
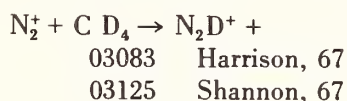
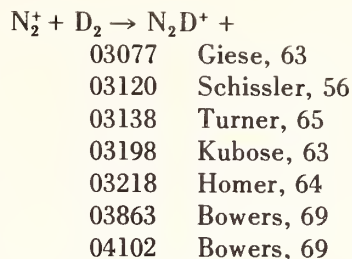
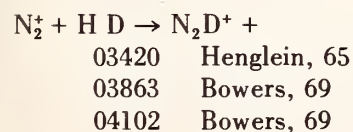
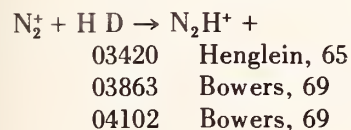
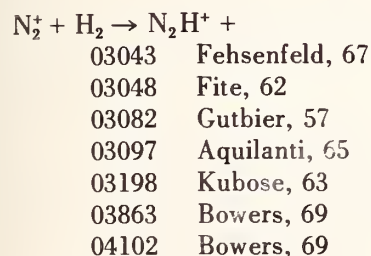
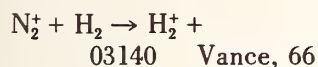
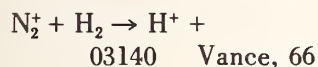
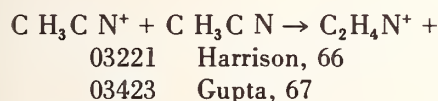
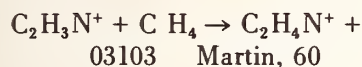
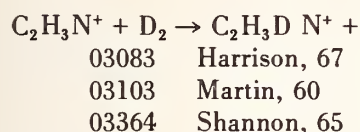
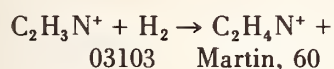
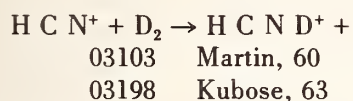
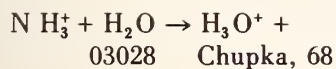


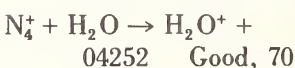
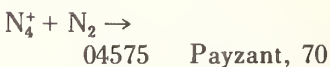
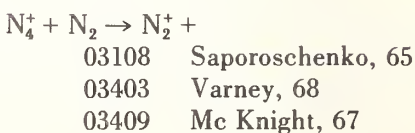
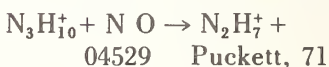
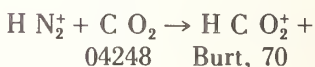
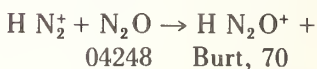
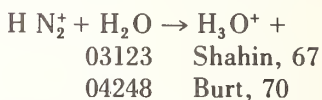
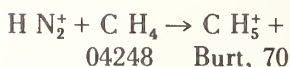
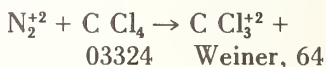
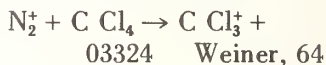
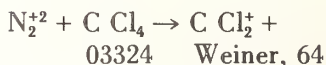
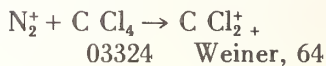
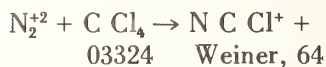
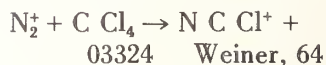
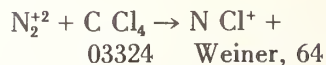
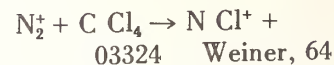
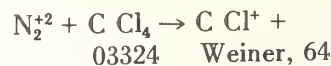
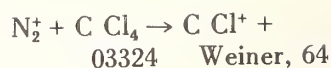
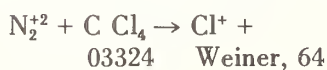
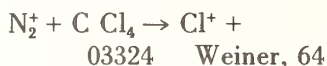
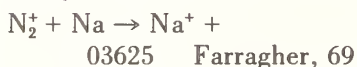
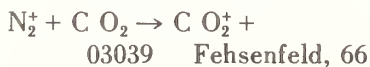
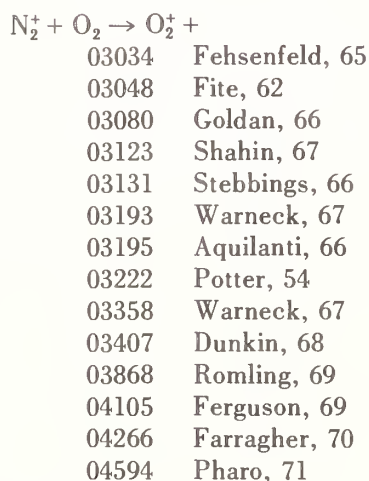
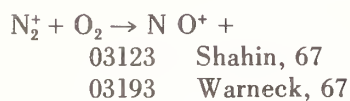
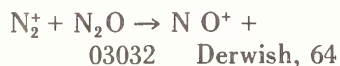
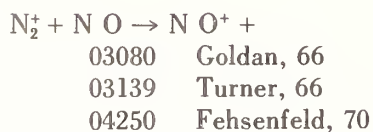
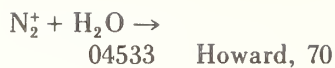






$N^+ + N O \rightarrow N O^+ +$	$N H^+ + N H_3 \rightarrow N_2 H^+ +$
03080 Goldan, 66	03366 Derwish, 63
03139 Turner, 66	
$N^+ + N_2 O \rightarrow N O^+ +$	$N H^+ + N H_3 \rightarrow N_2 H_2^+ +$
03032 Derwish, 64	03366 Derwish, 63
$N^+ + N_2 O \rightarrow$	$N H^+ + N H_3 \rightarrow N_2 H_3^+ +$
04533 Howard, 70	03366 Derwish, 63
$N^+ + O_2 \rightarrow N O^+ +$	$N H^+ + N_2 \rightarrow N_2 H^+ +$
03048 Fite, 62	03043 Fehsenfeld, 67
03080 Goldan, 66	
03131 Stebbings, 66	$N H_2^+ + H_2 \rightarrow N H_3 +$
03195 Aquilanti, 66	03043 Fehsenfeld, 67
03358 Warneck, 67	
$N^+ + O_2 \rightarrow O_2^+ +$	$N H_2^+ + N H_3 \rightarrow N H_3^+ +$
03080 Goldan, 66	03366 Derwish, 63
03131 Stebbings, 66	04390 Huntress, 71
03195 Aquilanti, 66	
03222 Potter, 54	$N H_2^+ + N H_3 \rightarrow N H_4^+ +$
03358 Warneck, 67	03423 Gupta, 67
04594 Pharo, 71	04390 Huntress, 71
$N^+ + O_2 \rightarrow$	$N H_2^+ + N H_3 \rightarrow N_2 H_3^+ +$
03407 Dunkin, 68	03366 Derwish, 63
04266 Farragher, 70	
04268 Johnsen, 70	$N H_2^+ + N H_3 \rightarrow N_2 H_4^+ +$
$N^+ + C O_2 \rightarrow C O_2^+ +$	03366 Derwish, 63
03039 Fehsenfeld, 66	
$N^+ + S F_6 \rightarrow S F_5^+ +$	$N H_2^+ + N H_3 \rightarrow$
04572 Fehsenfeld, 70	04574 Ryan, 70
$N^+ + C Cl_4 \rightarrow Cl^+ +$	$N H_3^+ + D_2 \rightarrow N H_3 D^+ +$
03324 Weiner, 64	03074 Giardini - Guidoni, 60
$N^+ + C Cl_4 \rightarrow C Cl^+ +$	$N H_3^+ + N H_3 \rightarrow N H_3^+ +$
03324 Weiner, 64	04390 Huntress, 71
$N^+ + C Cl_4 \rightarrow N Cl^+ +$	$N H_3^+ + N H_3 \rightarrow N H_4^+ +$
03324 Weiner, 64	03028 Chupka, 68
$N^+ + C Cl_4 \rightarrow N C Cl^+ +$	03074 Giardini - Guidoni, 60
03324 Weiner, 64	03091 Ryan, 65
$N^+ + C Cl_4 \rightarrow C Cl_2^+ +$	03225 Dorfman, 59
03324 Weiner, 64	03366 Derwish, 63
$N^+ + C Cl_4 \rightarrow C Cl_3^+ +$	03423 Gupta, 67
03324 Weiner, 64	04390 Huntress, 71
$N H^+ + H_2 \rightarrow N H_2^+ +$	$N H_3^+ + N H_3 \rightarrow N H_4^+ +$
03043 Fehsenfeld, 67	04574 Ryan, 70
	$N H_3^+ + H_2 O \rightarrow N H_4^+ +$
	03028 Chupka, 68





$N_4^+ + O_2 \rightarrow O_2^+ +$
 03123 Shahin, 67
 03195 Aquilanti, 66
 04568 Dunkin, 71

$N_4H_{13}^+ + N H_3 \rightarrow N_3H_{10}^+ +$
 04529 Puckett, 71

$O^+ + H \rightarrow H^+ +$
 03130 Stebbings, 68

$O^+ + H_2 \rightarrow O H^+ +$
 03043 Fehsenfeld, 67

$O^+ + N_2 \rightarrow N_2^+ +$
 03131 Stebbings, 66
 03222 Potter, 54

$O^+ + N_2 \rightarrow N O^+ +$
 02985 Bohme, 67
 03112 Nakshbandi, 67
 03119 Sayers, 64
 03122 Schmeltekopf, 67
 03131 Stebbings, 66
 03135 Talrose, 62
 03143 Batey, 65
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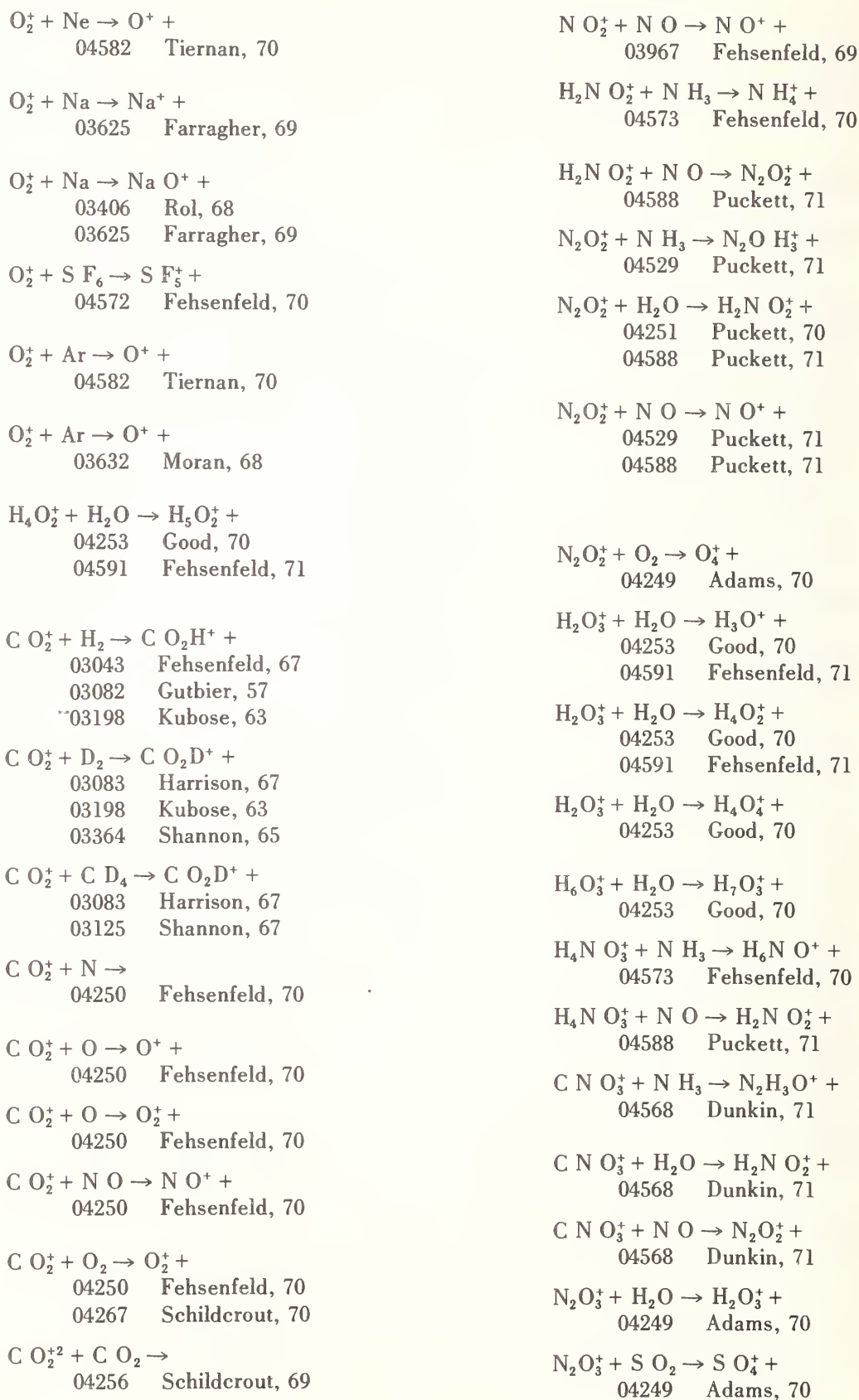
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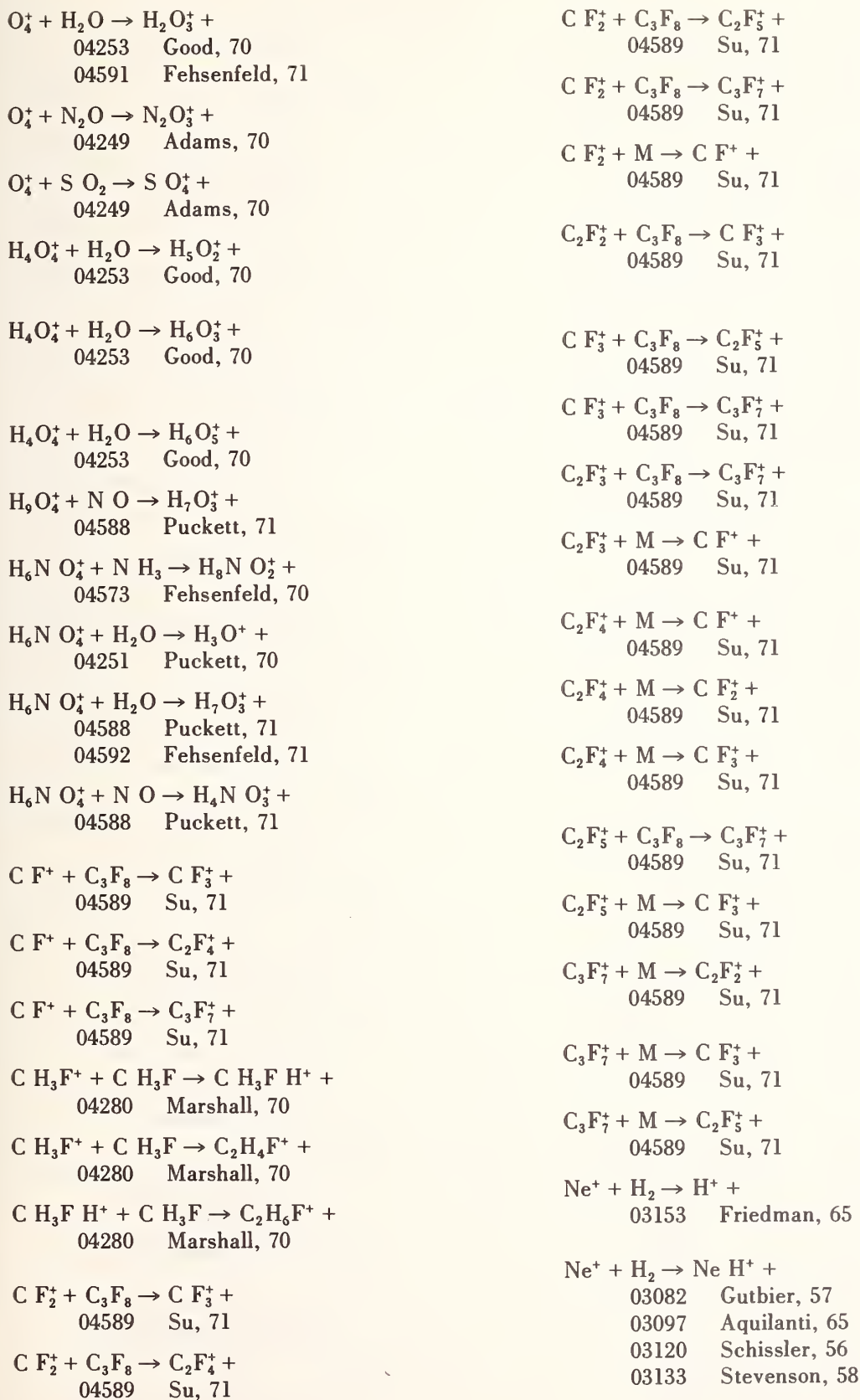
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$\text{K}^+ + \text{N O} \rightarrow$ 04596 Johnsen, 71	$\text{Kr}^+ + \text{D}_2 \rightarrow \text{Kr D}^+ +$ 03120 Schissler, 56
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$\text{K}^+ + \text{O}_3 \rightarrow \text{K O}^+ +$ 03405 Ferguson, 68	$\text{Kr}^+ + \text{C H}_4 \rightarrow \text{C H}_3^+ +$ 03325 Hertel, 65
$\text{K}^+ + \text{K} \rightarrow \text{K}^+ +$ 03365 Kushnir, 59 03855 Palyukh, 69	$\text{Kr}^+ + \text{C H}_4 \rightarrow \text{C H}_4^+ +$ 03104 Melton, 64 03224 Field, 62 03325 Hertel, 65 03858 Durden, 69
$\text{Ca}^+ + \text{O}_3 \rightarrow \text{Ca O}^+ +$ 03405 Ferguson, 68	$\text{Kr}^+ + \text{C H}_4 \rightarrow$ 04570 Jones, 71
$\text{Fe}^+ + \text{O}_3 \rightarrow \text{Fe O}^+ +$ 03405 Ferguson, 68	$\text{Kr}^+ + \text{C H}_4 \rightarrow \text{Kr H}^+ +$ 03224 Field, 62
$\text{As H}_3^+ + \text{D}_2 \rightarrow \text{As H}_3\text{D}^+ +$ 03074 Giardini - Guidoni, 60	$\text{Kr}^+ + \text{C H}_4 \rightarrow \text{Kr C H}_2^+ +$ 03224 Field, 62
$\text{As H}_3^+ + \text{As H}_3 \rightarrow \text{As H}_4^+ +$ 03074 Giardini - Guidoni, 60	$\text{Kr}^+ + \text{C H}_4 \rightarrow \text{Kr C H}_3^+ +$ 03224 Field, 62
$\text{H Br}^+ + \text{H Br} \rightarrow \text{H}_2\text{Br}^+ +$ 03120 Schissler, 56 03133 Stevenson, 58	$\text{Kr}^+ + \text{C}_2\text{H}_2 \rightarrow$ 04570 Jones, 71
$\text{H Br}^+ + \text{Kr} \rightarrow \text{Kr H}^+ +$ 03120 Schissler, 56	$\text{Kr}^+ + \text{C}_2\text{H}_4 \rightarrow$ 03199 Franklin, 61 04570 Jones, 71
$\text{C H}_2\text{Br}^+ + \text{C}_2\text{H}_5\text{Br} \rightarrow \text{C H Br}_2^+ +$ 03332 Theard, 62	$\text{Kr}^+ + \text{C}_2\text{H}_6 \rightarrow$ 04570 Jones, 71
$\text{C}_2\text{H}_5\text{Br}^+ + \text{C}_2\text{H}_5\text{Br} \rightarrow \text{C}_4\text{H}_9\text{Br}^+ +$ 03332 Theard, 62	$\text{Kr}^+ + \text{H}_2\text{O} \rightarrow$ 04533 Howard, 70
$\text{C}_2\text{H}_5\text{Br}^+ + \text{C}_2\text{H}_5\text{Br} \rightarrow \text{C}_4\text{H}_{10}\text{Br}^+ +$ 03332 Theard, 62	$\text{Kr}^+ + \text{N}_2\text{O} \rightarrow \text{O}^+ +$ 03100 Maier, 64
$\text{C}_2\text{H}_5\text{Br}^+ + \text{C}_2\text{H}_5\text{Br} \rightarrow \text{C}_2\text{H}_6\text{Br}_2^+ +$ 03332 Theard, 62	$\text{Kr}^+ + \text{N}_2\text{O} \rightarrow \text{N O}^+ +$ 03100 Maier, 64 03101 Maier, 65
$\text{C}_2\text{H}_5\text{Br}^+ + \text{C}_2\text{H}_5\text{Br} \rightarrow \text{C}_4\text{H}_{10}\text{Br}_2^+$ 03332 Theard, 62	$\text{Kr}^+ + \text{H Br} \rightarrow \text{Kr H}^+ +$ 03120 Schissler, 56
$\text{Kr}^+ + \text{H}_2 \rightarrow \text{Kr H}^+ +$ 03082 Gutbier, 57 03097 Aquilanti, 65 03120 Schissler, 56 03133 Stevenson, 58	

$\text{Kr}^+ + \text{Kr} \rightarrow \text{Kr}^+ +$
 04577 Jones, 70
 $\text{Kr C O}^+ + \text{C O} \rightarrow \text{C}_2\text{O}_2^+ +$
 03110 Munson, 62
 $\text{Ar Kr}^+ + \text{Kr} \rightarrow \text{Kr}_2^+ +$
 04289 Bohme, 70
 $\text{Kr}_2^+ + \text{Xe} \rightarrow \text{Kr Xe}^+ +$
 03328 Kebarle, 67
 $\text{Rb}^+ + \text{Rb}_2 \rightarrow \text{Rb}_2^+ +$
 03098 Lee, 65
 04106 Lee, 65
 $\text{I}^+ + \text{Hg} \rightarrow \text{Hg}^+ +$
 03033 Edmonds, 64
 $\text{C}_2\text{H}_5\text{I}^+ + \text{C}_2\text{H}_5\text{I} \rightarrow \text{C}_4\text{H}_{10}\text{I}_2^+$
 03104 Melton, 64
 $\text{Xe}^+ + \text{H}_2 \rightarrow \text{Xe H}^+ +$
 03097 Aquilanti, 65
 $\text{Xe}^{+2} + \text{H}_2 \rightarrow \text{Xe}^+ +$
 03097 Aquilanti, 65
 $\text{Xe}^+ + \text{C H}_4 \rightarrow \text{C H}_3^+ +$
 03325 Hertel, 65
 $\text{Xe}^+ + \text{C H}_4 \rightarrow \text{C H}_4^+ +$
 03325 Hertel, 65
 $\text{Xe}^+ + \text{C H}_4 \rightarrow \text{Xe H}^+ +$
 03224 Field, 62
 $\text{Xe}^+ + \text{C H}_4 \rightarrow \text{Xe C H}_2^+ +$
 03224 Field, 62
 $\text{Xe}^+ + \text{C H}_4 \rightarrow \text{Xe C H}_3^+ +$
 03224 Field, 62
 $\text{Xe}^+ + \text{C}_2\text{H}_4 \rightarrow \text{C H}^+ +$
 03101 Maier, 65
 $\text{Xe}^+ + \text{C}_2\text{H}_4 \rightarrow \text{C H}_2^+ +$
 03101 Maier, 65
 $\text{Xe}^+ + \text{C}_2\text{H}_4 \rightarrow \text{C}_2\text{H}_2^+ +$
 03101 Maier, 65
 $\text{Xe}^+ + \text{C}_2\text{H}_4 \rightarrow \text{C}_2\text{H}_3^+ +$
 03101 Maier, 65
 $\text{Xe}^+ + \text{C}_2\text{H}_4 \rightarrow \text{C}_2\text{H}_4^+ +$
 03101 Maier, 65
 $\text{Xe}^+ + \text{C}_2\text{H}_4 \rightarrow$
 03199 Franklin, 61

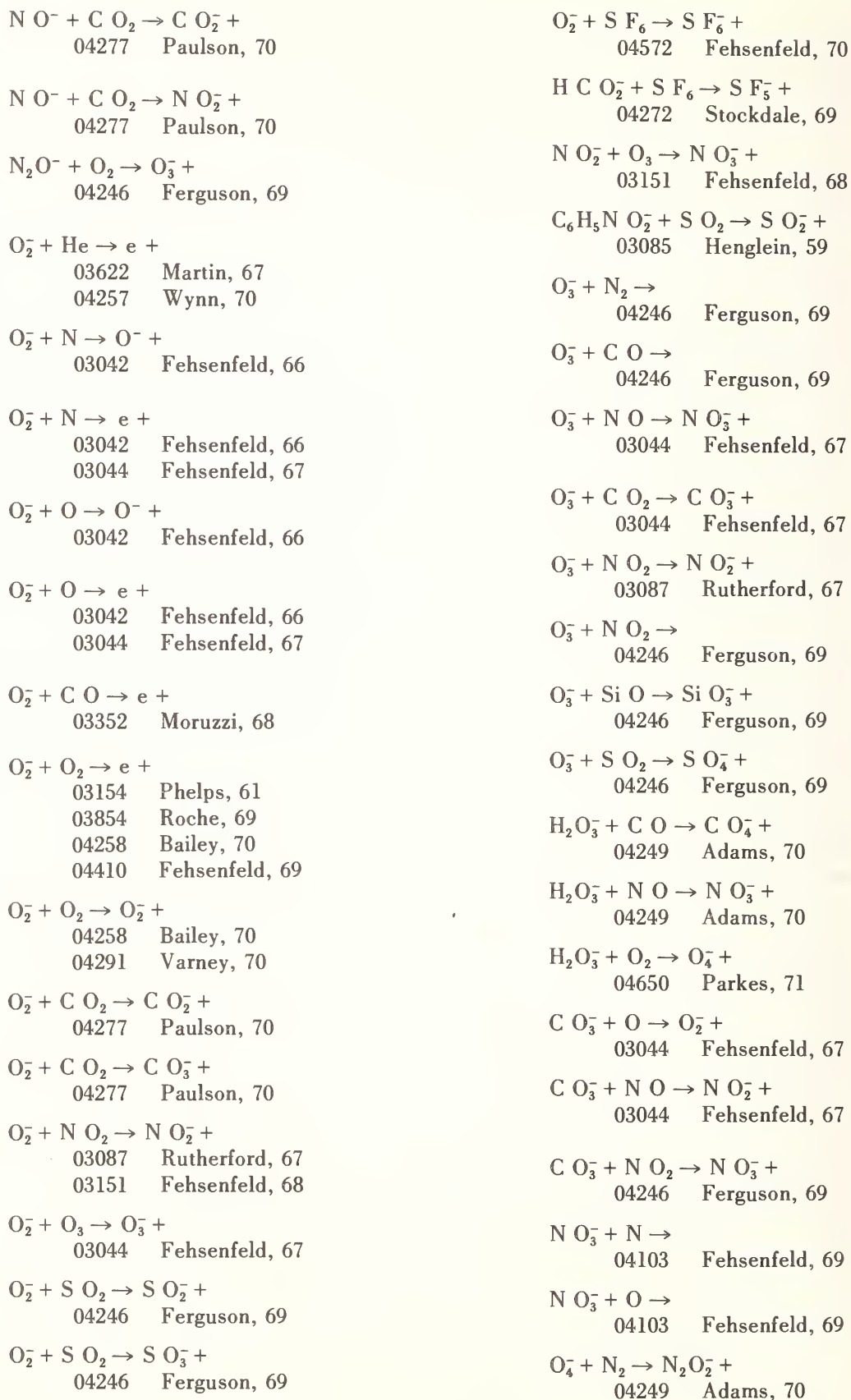
$\text{Xe}^+ + \text{Xe} \rightarrow \text{Xe}^+ +$
 03365 Kushnir, 59
 $\text{Kr Xe}^+ + \text{Xe} \rightarrow \text{Xe}_2^+ +$
 03328 Kebarle, 67
 $\text{Cs}^+ + \text{Cs} \rightarrow \text{Cs}^+ +$
 03365 Kushnir, 59
 03856 Palyukh, 69
 $\text{Cs}^+ + \text{Cs}_2 \rightarrow \text{Cs}_2^+ +$
 03098 Lee, 65
 04106 Lee, 65
 $\text{Ba}^+ + \text{N O} \rightarrow$
 04596 Johnsen, 71
 $\text{Ba}^+ + \text{O}_2 \rightarrow$
 04596 Johnsen, 71
 $\text{Hg}^+ + \text{O}_2 \rightarrow \text{O Hg}^+ +$
 03201 Herman, 63

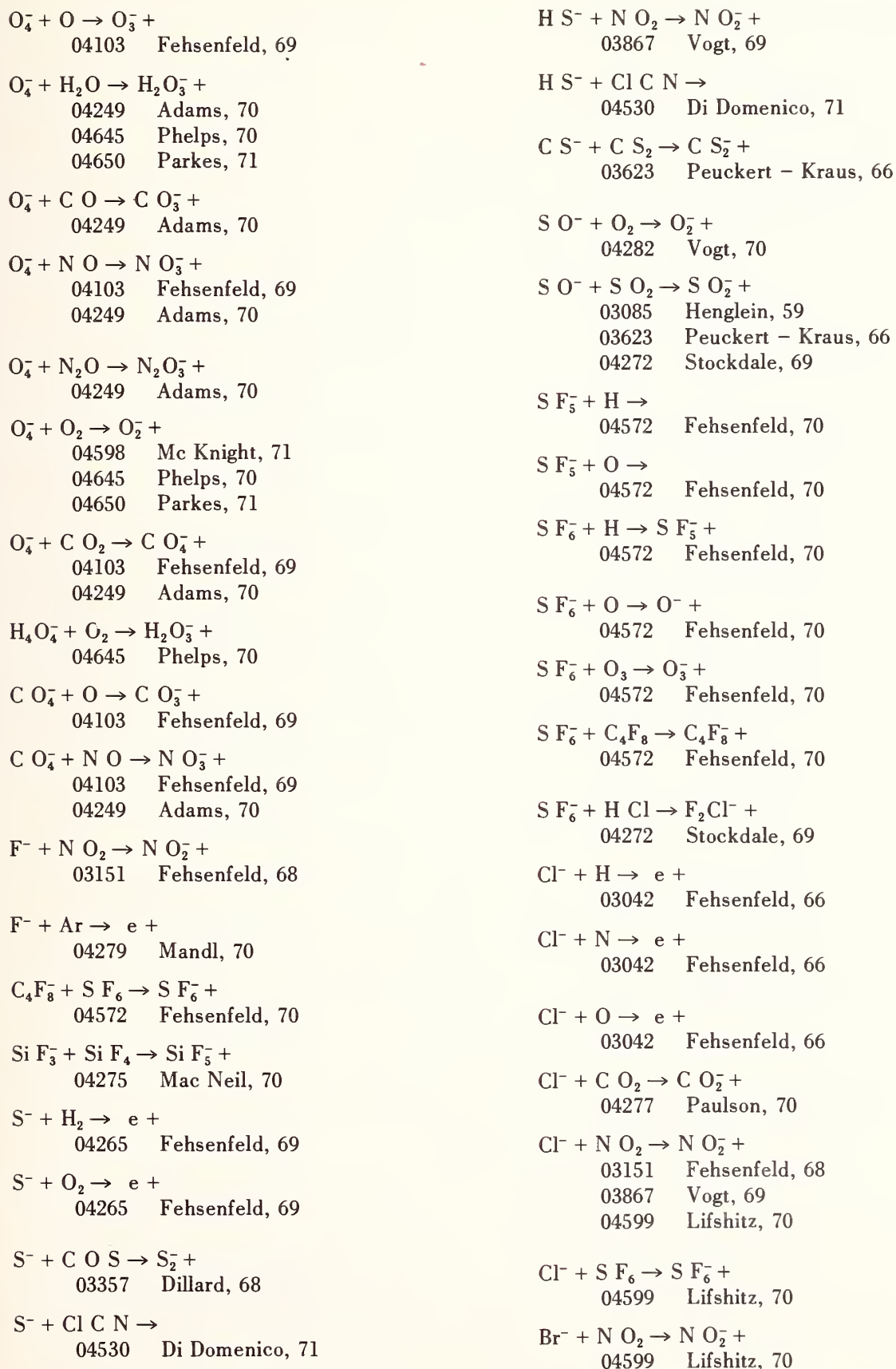
Two Body, Negative Ion-Neutral

$\text{H}^- + \text{H} \rightarrow \text{H}_2 + \text{e} +$
 03121 Schmeltekopf, 67
 $\text{H}^- + \text{He} \rightarrow$
 04293 Bailey, 57
 $\text{H}^- + \text{H}_2\text{O} \rightarrow \text{O H}^- +$
 03621 Stockdale, 68
 04272 Stockdale, 69
 $\text{H}^- + \text{C O} \rightarrow \text{e} +$
 04290 Dunkin, 70
 $\text{H}^- + \text{N O} \rightarrow \text{e} +$
 04290 Dunkin, 70
 $\text{H}^- + \text{N}_2\text{O} \rightarrow \text{O H}^- +$
 04290 Dunkin, 70
 $\text{H}^- + \text{O}_2 \rightarrow \text{e} +$
 04258 Bailey, 70
 04290 Dunkin, 70
 $\text{H}^- + \text{O}_2 \rightarrow \text{O}_2^- +$
 04258 Bailey, 70
 04282 Vogt, 70
 $\text{H}^- + \text{O}_2 \rightarrow$
 02979 Baker, 62

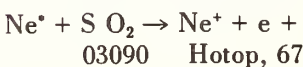
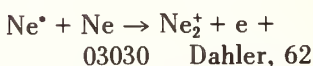
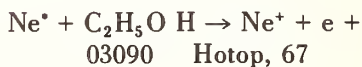
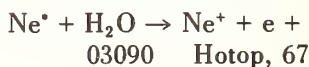
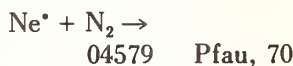
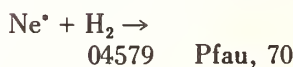
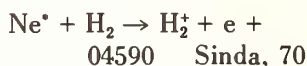
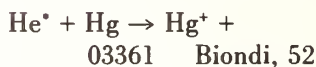
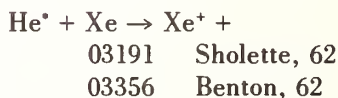
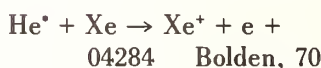
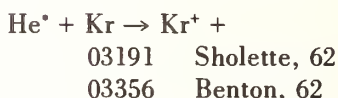
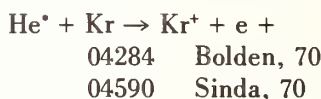
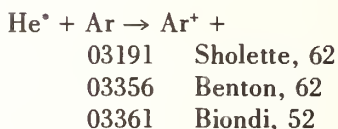
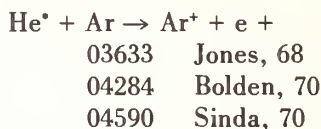
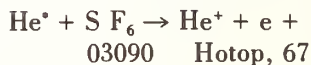
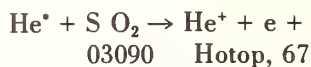
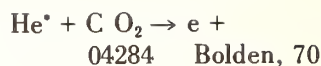
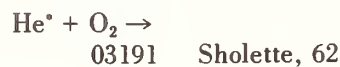
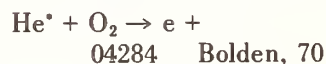
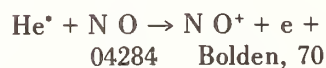
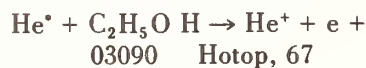
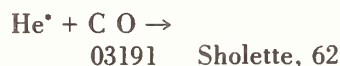
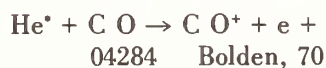
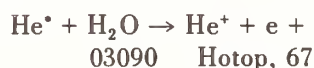
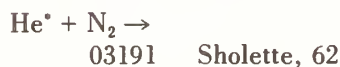
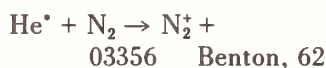
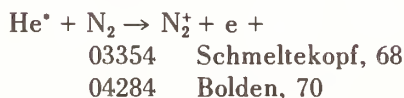
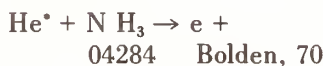
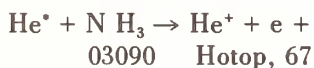
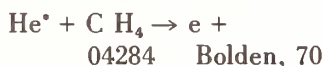
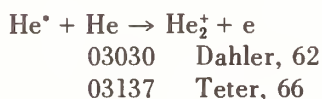
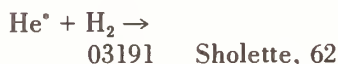
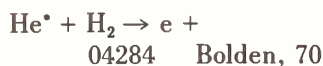
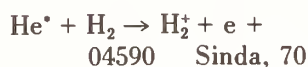
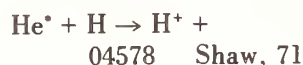
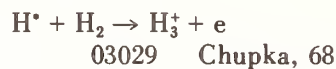
$H^- + N O_2 \rightarrow N O_2^- +$ 04282 Vogt, 70	$O^- + D_2 \rightarrow O D^- +$ 03617 Martin, 68 03622 Martin, 67
$H^- + Ne \rightarrow$ 04293 Bailey, 57	$O^- + He \rightarrow e +$ 04257 Wynn, 70
$H^- + Ar \rightarrow$ 04293 Bailey, 57	$O^- + C_2H_2 \rightarrow C_2H^- +$ 04254 Stockdale, 70
$D^- + D_2O \rightarrow O D^- +$ 03426 Paulson, 66 03621 Stockdale, 68 04272 Stockdale, 69	$O^- + C_2H_2 \rightarrow C_2O H^- +$ 04254 Stockdale, 70
$D^- + O_2 \rightarrow O_2^- +$ 04282 Vogt, 70	$O^- + C_2H_2 \rightarrow C_2H_2O^-$ 04254 Stockdale, 70
$D^- + N O_2 \rightarrow N O_2^- +$ 04282 Vogt, 70	$O^- + C_2H_4 \rightarrow C_2H_2^- +$ 04254 Stockdale, 70
$C^- + H_2 \rightarrow e +$ 04263 Fehsenfeld, 70	$O^- + C_6H_6 \rightarrow C_6H_4^- +$ 04254 Stockdale, 70
$C^- + C O \rightarrow e +$ 04263 Fehsenfeld, 70	$O^- + C_6H_6 \rightarrow C_6H_5O^- +$ 04254 Stockdale, 70
$C^- + N_2O \rightarrow$ 04263 Fehsenfeld, 70	$O^- + C_2D_2 \rightarrow C_2D^- +$ 04254 Stockdale, 70
$C^- + O_2 \rightarrow O^- +$ 04263 Fehsenfeld, 70	$O^- + C_2D_2 \rightarrow C_2O D^- +$ 04254 Stockdale, 70
$C^- + C O_2 \rightarrow e +$ 04263 Fehsenfeld, 70	$O^- + C_6D_6 \rightarrow C_6D_4^- +$ 04254 Stockdale, 70
$N H_2^- + C H_3O H \rightarrow C H_3O^- +$ 03331 Vogt, 67	$O^- + C_6D_6 \rightarrow C_6D_5O^- +$ 04254 Stockdale, 70
$N D_2^- + O_2 \rightarrow O_2^- +$ 04282 Vogt, 70	$O^- + N \rightarrow e +$ 03042 Fehsenfeld, 66 03044 Fehsenfeld, 67
$C N^- + Cl C N \rightarrow$ 04530 Di Domenico, 71	$O^- + N_2 \rightarrow e +$ 03042 Fehsenfeld, 66 03854 Roche, 69 04287 Compton, 70
$O^- + H_2 \rightarrow O H^- +$ 03042 Fehsenfeld, 66 03617 Martin, 68 03622 Martin, 67	$O^- + O \rightarrow e +$ 03042 Fehsenfeld, 66 03044 Fehsenfeld, 67
$O^- + H_2 \rightarrow e +$ 03042 Fehsenfeld, 66 03220 Moruzzi, 66 03352 Moruzzi, 68	$O^- + H_2O \rightarrow O H^- +$ 03867 Vogt, 69

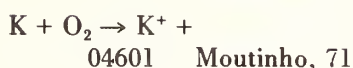
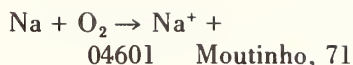
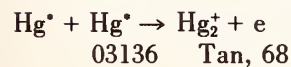
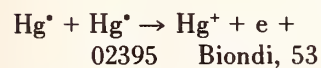
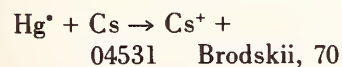
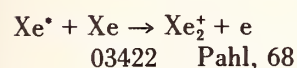
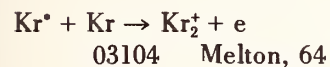
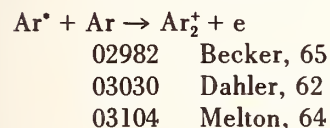
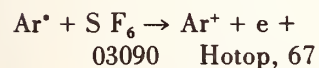
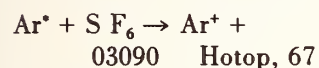
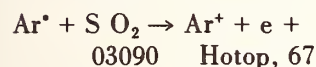
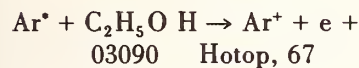
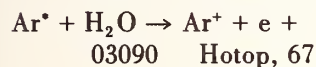
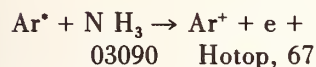
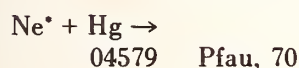
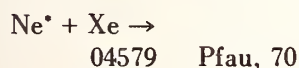
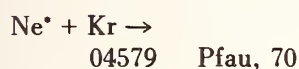
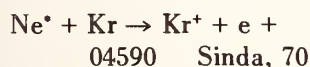
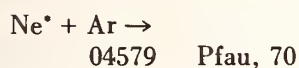
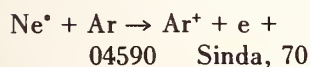
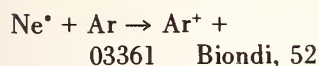
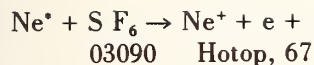
- $O^- + C O \rightarrow e +$
 03042 Fehsenfeld, 66
 03220 Moruzzi, 66
 03352 Moruzzi, 68
 03854 Roche, 69
- $O^- + N O \rightarrow e +$
 03042 Fehsenfeld, 66
 03352 Moruzzi, 68
- $O^- + N_2 O \rightarrow N O^- +$
 03426 Paulson, 66
 04272 Stockdale, 69
 04276 Paulson, 70
- $O^- + N_2 O \rightarrow N_2 O^- +$
 03426 Paulson, 66
- $O^- + N_2 O \rightarrow O_2^- +$
 04276 Paulson, 70
- $O^- + O_2 \rightarrow e +$
 03854 Roche, 69
 04258 Bailey, 70
- $O^- + O_2 \rightarrow O_2^- +$
 03144 Burch, 57
 03426 Paulson, 66
 03867 Vogt, 69
 04258 Bailey, 70
 04291 Varney, 70
 04389 Snuggs, 71
 04581 Kinsman, 70
- $O^- + O_2 \rightarrow e +$
 03042 Fehsenfeld, 66
 04410 Fehsenfeld, 69
- $O^- + C O_2 \rightarrow O_2^- +$
 04277 Paulson, 70
- $O^- + C O_2 \rightarrow C O_2^- +$
 04277 Paulson, 70
- $O^- + N O_2 \rightarrow O_2^- +$
 03426 Paulson, 66
- $O^- + N O_2 \rightarrow N O_2^- +$
 03085 Henglein, 59
 03087 Rutherford, 67
 03426 Paulson, 66
 03623 Peuckert - Kraus, 66
 03867 Vogt, 69
 04272 Stockdale, 69
- $O^- + C H_3 N O_2 \rightarrow C H_2 N O_2^- +$
 03085 Henglein, 59
- $O^- + C H_3 N O_2 \rightarrow C H N O_2^- +$
 03085 Henglein, 59
- $O^- + O_3 \rightarrow O_3^- +$
 03044 Fehsenfeld, 67
- $O^- + Ne \rightarrow e +$
 04257 Wynn, 70
- $O^- + C N Cl \rightarrow O C N^- +$
 03620 Dillard, 68
- $O^- + Ar \rightarrow e +$
 04257 Wynn, 70
- $O^- + Ar \rightarrow e +$
 03854 Roche, 69
- $O^- + C H_3 I \rightarrow O I^- +$
 03085 Henglein, 59
- $O^- + I Br \rightarrow O I^- +$
 03085 Henglein, 59
- $O^- + I_2 \rightarrow O I^- +$
 03085 Henglein, 59
- $O H^- + He \rightarrow e +$
 03622 Martin, 67
 04257 Wynn, 70
- $O H^- + N \rightarrow e +$
 03042 Fehsenfeld, 66
- $O H^- + O \rightarrow e +$
 03042 Fehsenfeld, 66
- $O H^- + O_2 \rightarrow e +$
 04258 Bailey, 70
- $O H^- + O_2 \rightarrow O_2^- +$
 04258 Bailey, 70
- $O H^- + O_2 \rightarrow$
 02979 Baker, 62
- $O H^- + N O_2 \rightarrow N O_2^- +$
 03087 Rutherford, 67
 03867 Vogt, 69
- $O H^- + C H_3 S H \rightarrow C H_3 S^- +$
 03331 Vogt, 67
- $N O^- + N_2 O \rightarrow N_2 O^- +$
 04276 Paulson, 70
 04278 Chantry, 69
- $N O^- + N_2 O \rightarrow N_3 O_2^-$
 03628 Moruzzi, 68
- $N O^- + O_2 \rightarrow O_2^- +$
 03042 Fehsenfeld, 66



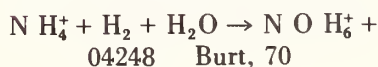
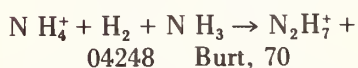
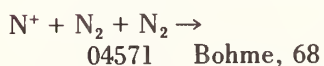
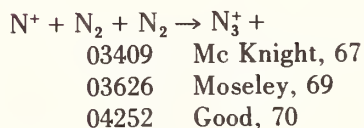
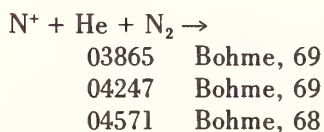
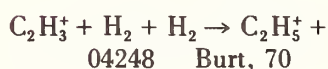
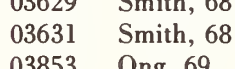
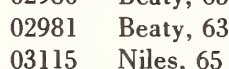
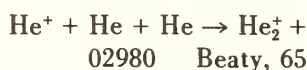
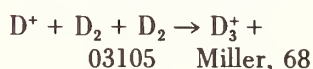
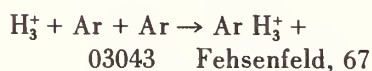
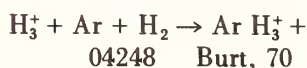
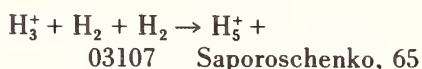
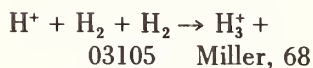


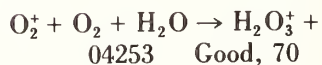
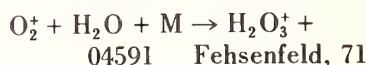
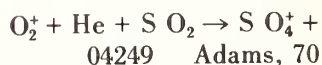
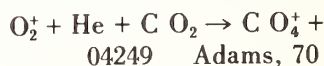
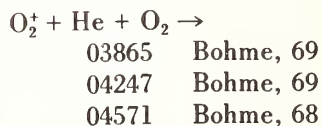
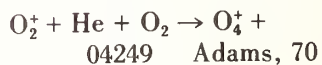
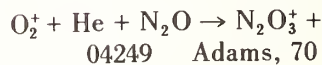
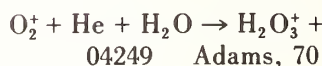
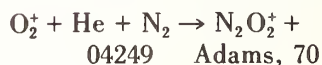
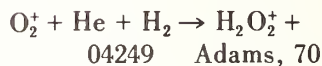
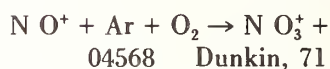
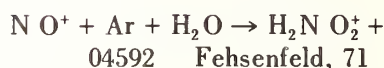
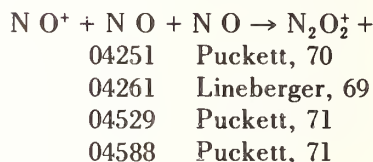
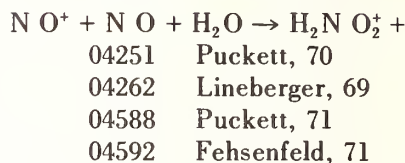
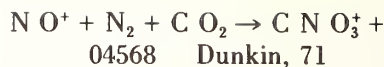
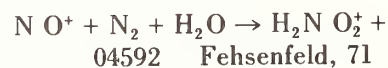
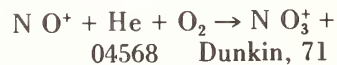
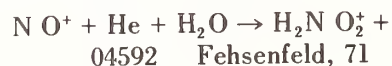
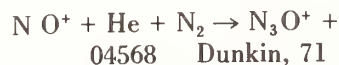
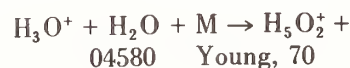
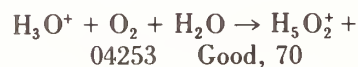
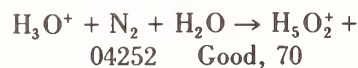
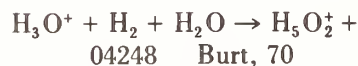
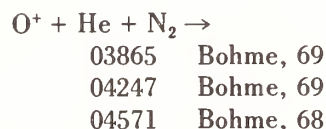
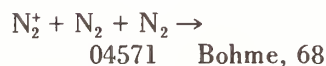
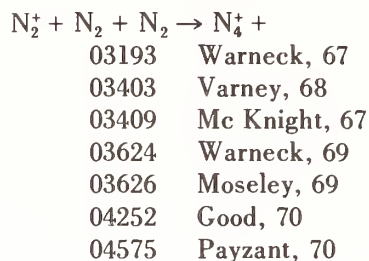
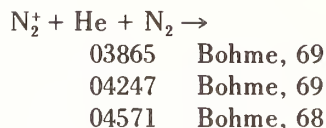
Two Body, Excited Neutral-Neutral



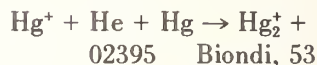
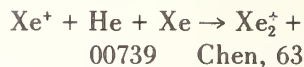
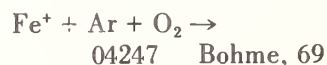
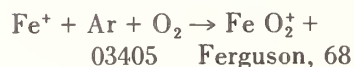
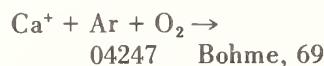
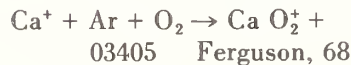
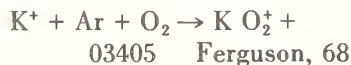
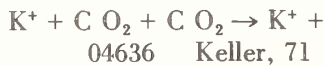
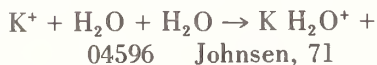
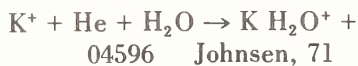
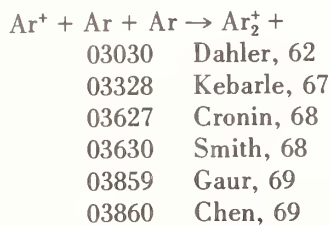
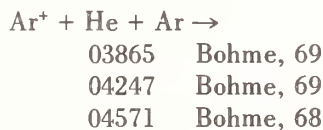
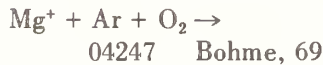
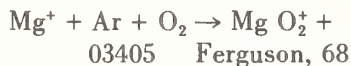
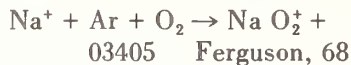
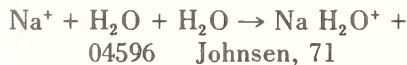
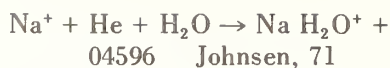


Three Body, Positive-Neutral-Neutral

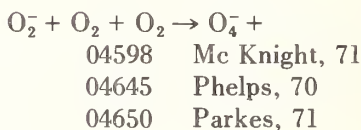
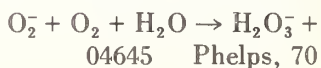
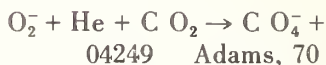
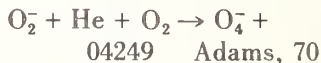
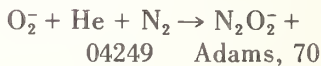
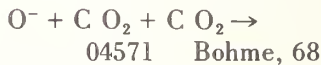
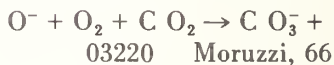
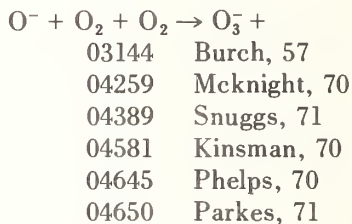
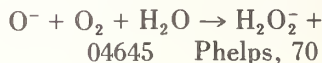
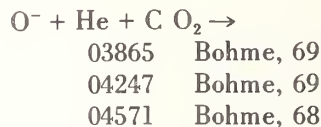
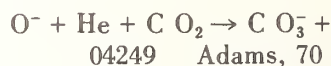
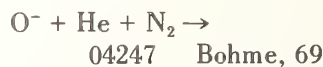
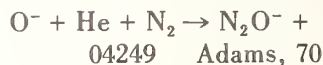


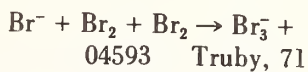
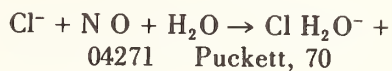
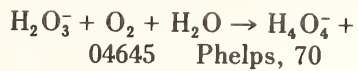
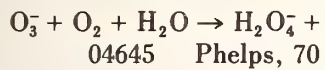
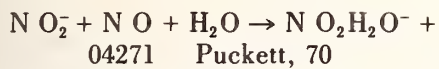
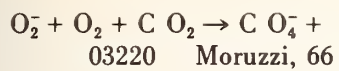


$O_2^+ + O_2 + O_2 \rightarrow O_4^+ +$ 03858 Durden, 69 04253 Good, 70	$H_7O_3^+ + Ar + H_2O \rightarrow H_9O_4^+ +$ 04592 Fehsenfeld, 71
$H_5O_2^+ + H_2 + H_2O \rightarrow H_7O_3^+ +$ 04248 Burt, 70	$H_4N O_3^+ + He + H_2O \rightarrow H_6N O_4^+ +$ 04592 Fehsenfeld, 71
$H_5O_2^+ + N_2 + H_2O \rightarrow H_7O_3^+ +$ 04252 Good, 70	$H_4N O_3^+ + N_2 + H_2O \rightarrow H_6N O_4^+ +$ 04592 Fehsenfeld, 71
$H_5O_2^+ + H_2O + M \rightarrow H_7O_3^+ +$ 04580 Young, 70	$H_4N O_3^+ + N O + H_2O \rightarrow H_6N O_4^+ +$ 04251 Puckett, 70 04588 Puckett, 71 04592 Fehsenfeld, 71
$H_5O_2^+ + O_2 + H_2O \rightarrow H_7O_3^+ +$ 04253 Good, 70	$H_4N O_3^+ + Ar + H_2O \rightarrow H_6N O_4^+ +$ 04592 Fehsenfeld, 71
$C O_2^+ + C O_2 + C O_2 \rightarrow C_2O_4^+ +$ 03329 Paulson, 64	$O_4^+ + He + N_2 \rightarrow N_2O_4^+ +$ 04249 Adams, 70
$H_2N O_2^+ + He + H_2O \rightarrow H_4N O_3^+ +$ 04592 Fehsenfeld, 71	$O_4^+ + He + O_2 \rightarrow O_6^+ +$ 04249 Adams, 70
$H_2N O_2^+ + N_2 + H_2O \rightarrow H_4N O_3^+ +$ 04592 Fehsenfeld, 71	$H_9O_4^+ + H_2 + H_2O \rightarrow H_{11}O_5^+ +$ 04248 Burt, 70
$H_2N O_2^+ + N O + H_2O \rightarrow H_4N O_3^+ +$ 04251 Puckett, 70 04588 Puckett, 71 04592 Fehsenfeld, 71	$H_9O_4^+ + He + H_2O \rightarrow H_{11}O_5^+ +$ 04592 Fehsenfeld, 71
$H_2N O_2^+ + Ar + H_2O \rightarrow H_4N O_3^+ +$ 04592 Fehsenfeld, 71	$H_9O_4^+ + N_2 + H_2O \rightarrow H_{11}O_5^+ +$ 04592 Fehsenfeld, 71
$N_2O_2^+ + He + N_2 \rightarrow N_4O_2^+ +$ 04249 Adams, 70	$H_9O_4^+ + N O + H_2O \rightarrow H_{11}O_5^+ +$ 04251 Puckett, 70 04592 Fehsenfeld, 71
$N_2O_2^+ + N O + N O \rightarrow N_3O_3^+ +$ 04251 Puckett, 70	$H_9O_4^+ + O_2 + H_2O \rightarrow H_{11}O_5^+ +$ 04253 Good, 70
$H_7O_3^+ + H_2 + H_2O \rightarrow H_9O_4^+ +$ 04248 Burt, 70	$H_9O_4^+ + Ar + H_2O \rightarrow H_{11}O_5^+ +$ 04592 Fehsenfeld, 71
$H_7O_3^+ + He + H_2O \rightarrow H_9O_4^+ +$ 04592 Fehsenfeld, 71	$Ne^+ + He + He \rightarrow He Ne^+ +$ 04602 Veatch, 70
$H_7O_3^+ + N_2 + H_2O \rightarrow H_9O_4^+ +$ 04252 Good, 70 04592 Fehsenfeld, 71	$Ne^+ + He + Ne \rightarrow He Ne^+ +$ 04602 Veatch, 70
$H_7O_3^+ + N O + H_2O \rightarrow H_9O_4^+ +$ 04251 Puckett, 70 04588 Puckett, 71 04592 Fehsenfeld, 71	$Ne^+ + He + Ne \rightarrow Ne_2^+ +$ 04602 Veatch, 70
$H_7O_3^+ + O_2 + H_2O \rightarrow H_9O_4^+ +$ 04253 Good, 70	$Ne^+ + Ne + Ne \rightarrow Ne_2^+ +$ 02189 Sauter, 66 02981 Beaty, 63 03030 Dahler, 62 03210 Beaty, 68 03336 Hackam, 66 03630 Smith, 68 03859 Gaur, 69 03860 Chen, 69
$H_7O_3^+ + H_2O + M \rightarrow H_9O_4^+ +$ 04580 Young, 70	



Three Body, Negative-Neutral-Neutral







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